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OUR UNUSED WATER POWERS.

People are disposed to consider as idle talk the predictions frequently made that the day is coming soon when all the power used in this country will be supplied by hydro-electric plants and that the steam plant will be driven out of existence. With steam plants growing in number and capacity as rapidly as they are at present, hardly any excuse exists for taking these predictions very seriously. There is good reason to suppose, however, that the day will come when a much larger proportion of the total power used will be derived from hydro-electric plants. Many low head water powers are being developed each year in the middle and eastern states, as well as high head plants in the mountain districts of the western half of the United States, and there is no justification for supposing that anything more than a beginning has been made. As the price of coal goes up, which it inevitably will do as time passes, the value of water power will increase enough to make investments worth while that could not have safely been made a few years ago. It is not the small rivers alone that are being considered at the present time. Propositions were recently made to utilize no less a stream than the Mississippi near Keokuk, while the Ohio River at certain points has been looked upon favorably from an engineering standpoint. A water power plant using an immense volume of water at a very low head is not regarded as such an unwieldy engineering scheme as it was a few years ago, thanks to the developments in low head turbines. The main questions are those of civil engineering and finance. Electrical engineering has made the utilization of water power at points distant from a market feasible, and on the civil engineer must fall the work of getting these low head water powers harnessed at a reasonable first cost, according to designs which will eliminate dangers from flood waters.

REGULATION OF WIRELESS TELEGRAPHY.

We notice that the German Government has adopted a code of regulations for wireless which will assuredly increase the usefulness of such service. Under this arrangement, shore stations with their great radius of action are given the initiative and take precedence of stations afloat. When a coast station calls, ships unless called keep silence, and ships are not supposed to try for the shore save in emergencies, until fairly within range, here assumed as 75 miles. There are various minor regulations which aim at keeping the ethereal peace. All the coastwise stations use the same wave length in transmitting, the standard taken being 365 meters. Eleven sending stations are available along the German coast, and thirteen liners under the German flag are registered for regular service.

All this is a step in the right direction, and it is a pity that a similar code cannot be made international pending such development in the art as may bring syntonism as a relief from the troubles of interference. To make wireless of great and immediate use some such step is at least temporarily necessary, and while we would be very far from approving restrictions that would impede progress, some concurrent action by the maritime powers is certainly necessary. It will not do to let warring systems defeat by promiscuous interference the one end which it is their common duty to promote. Nor should it be possible for stations of one nation to interfere by accident or design with the stations of another. If wireless is to be pushed to its maximum usefulness, it must cover the seas with an invisible network of communication, and it can do this only when all systems

of all nationalities unite in a recognized common policy and obey specified rules. A good beginning was made at the conference two years ago, but united action must follow a common consensus of opinion in order to produce any useful result.

FAR WESTERN DEVELOPMENT.

Such articles as that which appears in our present issue, relative to the electrical development in the vicinity of Portland, bring again forcibly to mind how large and generous a field for electrical exploitation that Far West and the Pacific Slope have been. The work around Portland is on a large scale and of great importance and interest, and it is evident that Oregon is a splendid territory for electric light, power and transportation. In like manner, California has already shown its leadership and originality in hydroelectric development, while the same state is virtually at the head of the list in the utilization of the telephone by the public. If the Californian ratios prevailed all over the country, the United States would be much farther advanced electrically than it now is. In electric mining the advances have been extraordinary, and yet it would seem that only a beginning has been made, from which the brightest future may be anticipated.

SOME PHASES OF RADIOMANIA.

From time to time we have raised a voice of warning against hasty acceptance of the fervid hypotheses that befog the ascertained facts of radioactivity. The need for sober judgment has been emphasized over and over again by the wild statements which have gone the rounds of the technical as well as the non-technical press. The latest of these has just forced itself upon our notice and calls for pointed comment. It is built around the following thesis: "It is sober fact that radium has shaken the law of gravitation, has set at apparent defiance the law of conservation of energy, has displaced the atomic theory, has rewritten chemistry, and has provided a new account of the ultimate constitution of the universe." Now, in the interest of scientific truth, be it set down that the statement just quoted is largely nonsense in each and every particular. Whatever the investigation of radioactivity may do in the fullness of time, it has not yet done any one of these things. It has in truth produced interesting results which some day will be co-ordinated, but in doing so it has unhappily stimulated the publication of all manner of ill-grounded hypotheses which in turn have befooled the credulous and the superficial. Such psychological phenomena accompany not infrequently new lines of investigation, whether these lead to important results or not. Their acute phase at this particular stage of the study of radioactivity is most unfortunate, since they divert attention from the really important features of the investigation and bring legitimate and sane research to the very verge of charlatanry.

The germ of a great generalization may lie in radioactivity, but it will come to fruition only after years of painstaking labor and weeding out of the rank hypotheses that are growing up around it. Radium is a good thing for the untrained investigator to keep away from, since there are plenty of indications that even the skilled are likely to be led astray by their enthusiasm. The exciting cause of the pseudo-scientific outbreak upon which we are commenting was the recent announcement that Burke, of Cambridge University, England, had succeeded in stimulating the appearance of life in a sterilized medium by means of radium, the omnipotent. Not having seen the experiments, we hesitate to pass judgment upon the actual facts, but we cannot be unmindful that within the past half century similar announcements have several times been made by reputable but mistaken investigators. In each case further research has completely discredited the alleged discovery. There is nothing inherently unbelievable in the production of organized life by purely chemical or physical processes, but on the other hand there has never been adduced evidence sufficient to establish even a remote probability of such an occurrence. The most that can be said from a scientific standpoint of the present case is that Burke has observed certain bodies under circumstances sufficiently unusual to require careful study in order to determine: First, whether they are organic structures; and, second, whether they may have arisen without infection of the culture medium. So far neither of these questions has been answered, and the bodies themselves are so minute as to make them very difficult of determination. But nothing yet has appeared inconsistent with the view that they are crystals and nothing more—and crystals have before this been mistaken for living organisms. That they do not respond like many crystals to polarized light is to be expected of bodies commensurate in size with the wave length of light.

The serious part of the whole matter is that it has resulted in carrying into a perfectly legitimate, even if inconclusive, research, the flamboyant methods of the professional advertising manager. And the same stigma attaches to a great deal of recent scientific and quasi-scientific work. It is shame and dishonor to some institutions of learning that they allow their laboratories to be the prey of sensation mongers. Brilliant and successful research brings fame without recourse to the clap-trap contrivances dear to the advance agent of the circus. And the worst of it all is that such methods bring discredit upon work which might turn out to be of permanent value if it could but escape them. Radioactivity, more's the pity, has been exploited until it is coming to be the very shibboleth of quacks, and the mightiest spell in the conjuring book of pseudo-science. It is high time that the serious and capable workers in that really important field of investigation followed the example of Newton and of Darwin, and wrought patiently and silently until hypothesis has been transmuted into verified fact. One great research well finished is worth more to the world than a hundred hastily published suppositions. We would not condemn, but admonish those who have erred—they are punished enough by seeing their grotesque images in the distorted mirrors held up for all the world to see by bogus savants—and very often they are innocent, as shown by their frenzied protest against statements, ideas and experiments attributed to them wholly without warrant or excuse.

IMPROVEMENTS IN THE EDISON LAMP.

A paper published in the July number of the Journal of the Franklin Institute was read last March before the electrical section of that body by Mr. J. T. Marshall upon the development of the manufacture of the Edison incandescent lamp from 1881 to 1905. The article is interesting in itself and derives new interest from the remarkable improvements in the lamp announced recently by Mr. John W. Howell, before the Institute. In 1881 the average number of Edison incandescent lamps manufactured per working day was about 100. In 1905 the corresponding number was 150,000. The increase in lamp manufacture was thus 1,500 fold in that time. The 16-cp lamps of 1881 had a power consumption of 5.8 watts per mean horizontal candle, or 8 lamps per electrical horse-power. The 16-cp lamps of 1905 were mostly of 3.1 watts per candle or 15 per horse-power. The efficiency of the 16-cp Edison lamp has nearly doubled in the interval. The selling price of the 1881 16-cp lamp was 65 cents and that of the 1905 lamp 16 cents; so that the price has been reduced to one-quarter of the original. Moreover, the lamps of 1881 are stated to have been sold at a loss and the actual cost apiece is

stated to have been more than $1.30; so that the manufacturing cost per lamp appears to have been reduced to less than one-eighth.

Nevertheless, the Edison lamp of to-day has the same number of component parts as the lamp of 1881, and to an unskilled eye, the two lamps side by side would look much alike. The principal reduction in the cost of the lamp has been due to the replacement of hand labor by machine labor. Most of the operations involved are effected by machine. The filament is of artificial cellulose, or carbonaceous material, squirted through a small hole, in considerable lengths; whereas the original filament was a hand-cut strip of bamboo fibre. Almost all of the glass-blowing operations are now performed by machinery; whereas the original lamps had all the glass-blowing work done by hand. The glass balls used to be all free-blown by the workman, so that no two bulbs were exactly alike in size. Now they are all molded, so that except for microscopic differences all the bulbs have just the same size. It is curious that the only two operations which have remained hand work, and almost unchanged from the first, are the pasting of the ends of the filament to the terminal wires, and the soldering of the terminal wires to the metal electrodes in the base. It seems unlikely that any machine can compete with a workman in these processes, which call for special selective manipulation. Great interest attaches to the process of exhaustion of the bulbs. A very high degree of vacuum is required. It used to be necessary to exhaust the lamps by Sprengel mercury pumps. Now mechanical pumps, aided by the red phosphorus process, exhaust the lamps much more quickly and conveniently.

The lifetime of a lamp used to be the time of glowing which elapsed under normal conditions until the filament broke; although the candle-power of the lamp might be less than 50 per cent of the original. Now the lifetime is considered the time that it takes while glowing to fall off by 20 per cent in original normal candle-power, or down to 80 per cent of the original. Some figures are given in the paper in tabular form contrasting the lifetime (in the new sense defined above) of 16-cp lamps arranged to work at various efficiencies from one-fifth to one-half of a normal mean horizontal British candle-power per watt. Analyzing these figures, it would appear that the lifetime at the high consumption of five watts per candle is 220 times as long as that at the low consumption of two watts per candle. From this it would appear that the lifetime varies directly as the fifth or sixth power of the consumption. This is a terrible example of the hyperstrenuous life if there be any analogy between lamps and human beings. Between the limits of one-third and one-fifth candle per watt, a formula for the lifetime which fits the results very closely is that the common logarithm of the lifetime in hours equals 5.478 reduced by 8.7 times the illumination expressed in candles per watt. It would be wonderful, indeed, if the next quarter of a century could effect improvements in incandescent lamps comparable to that effected in the quarter century just pasesd. Already, however, remarkable improvements in carbon filaments are foreshadowed, and possibly tantalum, osmium or other filaments may come also into general use. eral use.

THE THEORY OF THE ELECTROLYTIC RECTIFIER.

A recent number of the *Physical Review* contains an account of a research by Mr. S. R. Cook to ascertain the cause of the obstruction offered to electric current by the aluminum electrolytic rectifier. It is manifest that the obstruction must be due either to resistance or to c.e.m.f., or to both causes in part. It is sometimes very difficult to determine how much of an electric obstruction is due to resistance, and how much to c.e.m.f. For example, it used to be supposed for many years that the difference of potential between the carbons of an ordinary direct-current arc lamp were due to a c.e.m.f. of 30 or more volts. Now, however, it is generally believed that the maximum value of the c.e.m.f. in an arc is only about 1 volt, and that all the rest of the potential difference is attributable to the resistance of the carbon vapor stream. Practically the only way of clearly deciding between the two rival hypotheses in any given case is by breaking the circuit and ascertaining whether there is any residual e.m.f. in the obstruction. If there be nothing but resistance in the obstruction, then the e.m.f. will vanish instantly with the removal of the current. If, on the other hand, there be a c.e.m.f. present, it will tend to persist and reveal itself after the cessation of the current. The ordinary voltameter, or coulombmeter, is a case in point. In this apparatus the c.e.m.f. of polarization persists after the removal of the polarizing current. In the arc lamp, on the contrary, only traces of c.e.m.f. are discoverable after the removal of the current.

In the case of the aluminum rectifier, the paper shows that if the exciting current be withdrawn there is a relatively large residual c.e.m.f. which gradually disappears. For example, with an applied e.m.f. of 26 volts, and a current of about 26 milliamperes, the apparent resistance of the device was 1,000 ohms; but after shutting off the current the c.e.m.f. after 0.01 second was 24.6 volts, after 1 second 14 volts, after 10 seconds 3 volts and after 50 seconds 2 volts. The c.e.m.f. fell off, therefore, 50 per cent in about 1 second. The actual resistance of the device, as computed on these observations, was approximately 100 ohms, although that figure may be open to discussion.

The conclusions reached from the observations are that the film of hydroxide formed on the aluminum anode acts as a dielectric to the ions swimming in the electrolyte. A condenser is thus virtually formed by the film, between the anode plate on one side and the electrolyte on the other. The condenser yields a c.e.m.f. after the removal of the charging current, subject to loss of charge by leakage through the film. This loss of charge seems to occur more slowly than would take place through a wire joining the plates of the condenser and having a resistance equal to that evaluated from the observations. The percentage loss of charge is more rapid at the outset than at later instants, showing that the loss of charge in the condenser is greatest at the outset; or that the resistance of the dielectric in the condenser continually increases as the pressure falls by leakage. Finally, when the pressure has fallen to 2 volts, the rate of diminution in charge becomes very low.

The size of the aluminum plates used does not appear in the paper; but a capacity of one-seven-hundredth part of a farad would fall to half charge through one thousand ohms in about one second of time. According to Nodon's observations, the capacity of an electrolytic rectifier film may be as high as 10,000 microfarads per square centimeter for very minute areas, and 10 microfarads per square centimeter for plates of ordinary size. On the latter value the size of plate for the seven-hundredth part of a farad would be only about five inches square. It would seem, therefore, as though the electrolytic rectifier formed a dielectric film of hydroxide having extremely small thickness, and extremely large capacity as a condenser. Consequently, such a film holds a relatively large electric bound charge. The removal of the charging e.m.f. permits this charge to leak through the resistance of the dielectric, which, even although only about one megohm per square centimeter, enables the voltage to persist for a very appreciable time as c.e.m.f.

The Testing of Rubber-Insulated Wire.

The Wire Inspection Bureau affiliated with the Underwriters' Laboratories of Chicago and New York has issued an important circular signed by Mr. Hugh T. Wreaks, secretary, as to the testing of rubber-insulated wire. The governing committee whose names are given on the circular are W. H. Merrill, Jr., C. M. Goddard, J. C. Forster, Ira W. Henry, W. M. Habirshaw and G. A. Cragin. We quote the circular in full below, as follows:

On May 22, 1905, a conference was held at the rooms of the National Board of Fire Underwriters, the purpose of the meeting being to devise ways and means of testing all rubber-insulated wire manufactured under the rules of the National Board of Fire Underwriters, and to prevent the introduction into commercial use of any such wire which would prove inferior to the standard demanded by the National Board of Fire Underwriters. This to protect reliable manufacturers against unfair competition, and practically preventing any further use of wire with defective rubber insulation.

At this meeting a joint committee was chosen, consisting of six members, to form the Wire Inspection Bureau, this bureau to draw specifications for testing of rubber-insulated wire manufactured under the rules of the National Board of Fire Underwriters, to decide on such tests, and when and how they are to be made. Also to appoint the necessary electrical inspectors, three being considered sufficient at present, which inspectors shall from time to time visit the testing laboratories of any factories making rubber-insulated wire and make, supervise and verify tests specified by the bureau.

The expenses of these inspectors to be paid by fees collected from the manufacturing companies whose product is tested, each company paying its share in proportion to the amount of wire manufactured.

For the purpose of collecting the money to cover these expenses, stamps will be issued by the Wire Inspection Bureau and sold to the different manufacturers at a charge of one cent per hundred feet of wire tested, these stamps to be attached to the coils of tested wire by the manufacturers themselves, and to serve as a guarantee that wire so stamped has successfully withstood the tests specified by this bureau.

The majority of the rubber-covered wire manufacturers have recently agreed that on and after October 1, 1905, all National Code wire manufactured by their companies will be made up under the new specifications and duly tested, and will bear identification mark of the Wire Inspection Bureau. It is understood that a reasonable time will be allowed after this date for the disposal of code wire not bearing the stamp of approval of the Wire Inspection Bureau, on all such wire manufactured before October 1, 1905, and with this understanding the October list of electrical fittings will contain the names of all rubber-covered wire manufacturers agreeing to the tests of the Wire Inspection Bureau on their products, and to the use of identification stamps of the Wire Inspection Bureau guaranteeing that these tests have been properly made.

The Wire Inspection Bureau will supply identification stamps to the rubber-covered wire manufacturers as may be required by the latter, and on receipt of their order for the same. These stamps will be for 250-ft., 500-ft. and 1,000-ft. coils, and will cost at the rate of one cent per 100 ft. No wire will be considered as having been tested which does not contain an identification stamp (stamps to be of linen paper and to be securely fastened to the shipping tags attached to wire coils). Stamps will have serial numbers and on coils of less than above specified lengths where stamps specify more wire than coil contains, a credit for excess in stamp value can be obtained from the Wire Inspection Bureau on presentation of the facts in writing, giving size of wire, destination, number of feet and serial number of stamp used. All stamps to be canceled by manufacturer when used, the date of manufacture of wire also being plainly shown. Wire Inspection Bureau specification giving factory tests which will be required on all wire having approved stamps will be ready in a few weeks, and will be furnished to manufacturers of National Electric Code Wire.

Kindly read this letter over carefully, so that we may be sure that you understand the plan given, and in order that no apparent discrimination may be made against you next October through your not being fully advised of the scope and intent of the Wire Inspection Bureau.

Advise whether or not you decide to avail yourself of the services offered so that we may plan accordingly, and let us know as soon as possible how many identification stamps you will require and the proportionate number for 250-ft., 500-ft. and 1,000-ft. coils.

The Situation in Single-Phase Traction.

BY C. F. SCOTT.

On July 22 the ELECTRICAL WORLD AND ENGINEER published a letter from Mr. John Whitehouse, commenting upon a brief summary given in your editorial, July 8, referring to an article by me in the *Electric Journal* for June relative to single-phase traction. I think it likely that the impression of the writer of the letter that there was an unwarranted enthusiasm in the original article, and that its conclusions presumed to settle forever the problem of heavy traction, may be due to the fact that the communication was based solely upon your brief editorial and not upon the article itself. The letter seems to deal with the single-phase system in a somewhat academic manner, which may result from the writer's lack of information as to the advance which is being made in single-phase apparatus.

The several points given at the end of my article, noted in the editorial, are not given simply as a personal view, but as "the legitimate conclusion from the foregoing statements" which form the body of the article. Reference is made to a general discussion in which B. J. Arnold, H. Ward Leonard, A. H. Armstrong and W. B. Potter took part, showing that there was a desideratum in heavy traction work, which at that time (June, 1902) had not been secured. The single-phase series motor did not figure in the discussion as a practicable alternative, but only as an unobtainable phantom. The article continues by referring to the comments upon the single-phase motor presented by Mr. Lamme, in his paper before the American Institute of Electrical Engineers in September, 1902. Mr. Steinmetz, for example, said "that alternating-current railroading will become feasible only when the single-phase motor is developed giving the characteristics of the series motor." Hence the conclusion that engineers are in substantial agreement "that the use of single-phase alternating current is essential for heavy and long-distance railway service."

It appears, moreover, that the opinion of the writer of the letter regarding the importance of the single-phase system is in accord with the views upon which my conclusion was based, for after referring to the three-phase tests at Zossen he adds, "Albeit, no one is disposed to deny that single-phase current, other things being equal, would be more convenient and would generally be preferred." Further on he expresses the hope that the enthusiasm for the single-phase system "will prove well founded, for complete success would mean a revolution in railroading."

A further conclusion in my article, viz.: "that a single-phase motor and single-phase system fulfilling the ideal requirements have been developed" is substantiated by the fact that a number of single-phase railways are in operation and numerous others are under construction, both in this country and abroad, which fulfill the ideal requirements, which are in the main: the employment of a single high-voltage, alternating-current trolley wire; a motor with series characteristics; a voltage control enabling efficient acceleration and efficient operation over a wide range of speed.

The present status of the single-phase railway may be gauged by comparing the number of manufacturing companies in America and Europe presenting single-phase railway motors with those advocating three-phase motors, and by comparing the number of roads of each kind which are now under construction and for which orders have been received. It is not three years since the single-phase motor was presented to the public, while three-phase railways have been in operation in Europe for many years.

Discarding possible future discoveries and inventions and considering the apparatus and methods which are now available, the conclusions which I gave are a well-grounded summary of the views which have been expressed by prominent engineers, as well as representing my own views.

The Independent Telephone Situation in St. Louis.

Advices from St. Louis state that all the arrangements have been completed for the carrying out of the plan by which the Kinloch Long Distance Telephone Company, of Missouri, absorbs the Kinloch Telephone Company, of St. Louis. The shares of the local company, representing the issued capital stock of $2,000,000, were exchanged July 7, share for share, for stock of the long distance

company. The authorized capital of the latter corporation is $5,000,000, of which $2,800,000 has been issued, including the shares exchanged for the Kinloch Telephone Company stock. The companies, while owned by the same interests, will be conducted as heretofore by separate managements and officers. They will be financed jointly, however, and governed by the same directors. Samuel M. Kennard, president of the Kinloch Company, has resigned because of ill health and the press of private business, which requires much of his time. Wm. F. Nolker, first vice-president, was elected to succeed him. In the long distance company the directors are Adolphus Busch, C. Marquard Forster, August Gehner, Breckenridge Jones, Sam. M. Kennard, W. F. Nolker, Rolla Wells, Philip Stock, Julius S. Walsh, Wm. D. Orthwein, W. J. Lemp, James Green and Henry Nicolaus. The Kinloch directors are Adolphus Busch, C. Marquard Forster, August Gehner, Breckinridge Jones, S. M. Kennard, Wm. D. Orthwein, Charles H. Ledlie, W. J. Lemp, Henry Nicolaus, Philip Stock and Julius S. Walsh. C. Marquard Forster is president of the Long Distance Company.

One of the directors states that the reason for the arrangement was that it would considerably simplify the handling of the properties. The Long Distance Company is in much better position to finance future needs than the local corporation. He said that the old order of affairs frequently caused awkward situations and friction. The Long Distance Telephone Company July 12, filed in St. Louis a mortgage on all its properties for $5,000,000, securing the authorized issue of bonds. The American Trust & Savings Bank of Chicago and George M. Galbreath are trustees for the bondholders. The authorized stock and bonds of the Long-Distance, other than what has been issued, will be used for additions and improvements to be paid for at 90 per cent of the cost. The other 10 per cent must be provided for by the company. The offices of both companies will be located in the new Kinloch building now in course of construction.

Notes on the Electrical Contractors' Boston Meeting.

Considerable space was given in the July 22 issue of the ELECTRICAL WORLD AND ENGINEER to the convention and exhibition of the National Electrical Contractors' Association in Boston. Although the meetings were held with closed doors, we are indebted to Secretary W. H. Morton for a brief synopsis of what was done.

The meeting was one of the most successful that the association has ever held, there being a registered attendance of 180 members, many of these being delegates for a number of members. The first session, which was held on July 19 at 10 o'clock, was an open session, to which all persons interested in electrical business were invited. The meeting was opened by an address of welcome by Mr. Frank L. Barnes, president of the Massachusetts State Association. This was responded to by Mr. E. McCleary, president of the National Association, in a speech outlining the work of the National Association and especially bringing out the point that the entire efforts of the association were devoted to the upbuilding of the electrical contracting trade.

Mr. F. E. Cabot, chairman of the electrical committee of the National Board of Fire Underwriters, spoke on the subject of electrical inspection and the National Electrical Code.

Mr. T. Beran, of New York, spoke for the manufacturers and in an able address outlined the position of the manufacturer toward the electrical trade. Mr. James Cole, of Boston, chief of the wire department, spoke on the relations of the city of Boston to the electrical contractors. Mr. G. M. Stuart, of Boston, spoke for the jobbers, and pointed out the rapid growth of the electrical business during the past ten years. A general discussion followed these speeches and closed the open session.

The delegates met in executive session on Wednesday afternoon, Thursday and Friday, and at the close of the meeting elected the following officers: President, James R. Strong, New York City; first vice-president, W. I. Gray, Minneapolis; second vice-president, W. C. McIntire, Philadelphia; third vice-president, F. E. Newbery, St. Louis; treasurer, John R Galloway, Washington; secretary, W. H. Morton, Utica; sergeant-at-arms, J. C. Sterns, Buffalo.

The social features of the convention were many and extremely well executed. On Wednesday evening there was a banquet for members only at Hotel Brunswick, at which about 160 members were present. An excellent vaudeville performance was given in connection with the banquet and Mr. McCleary, the retiring president, was given a most enthusiastic reception.

On Thursday the members of the association and their guests were taken on a special boat for a trip around Boston Harbor, ending at Nantasket, where a shore dinner was served to about 560 persons. After the dinner the entire party spent the evening at Paragon Park.

On Friday evening a reception was gotten up by the ladies and was given in Paul Revere Hall, Mechanics' Bnilding. This was largely attended and dancing was enjoyed until a late hour. At the close of the reception Mr. McCleary was presented with a handsome silver table service given to him by the membership as a token of their appreciation of the time and work which he has devoted to the organization.

During the three days of the convention the ladies were entertained by numerous trolley trips and automobile rides to the historic points near Boston. Too much credit cannot be given to the committee of the Massachusetts Association, who were in charge of the convention. In spite of the extremely hot weather a most interesting and enjoyable meeting was held, and the visit to Boston will be long remembered as one of the most successful episodes in the history of the body.

Electric Power in Mines.

A very interesting and intelligent statement on electric power in mining has been made at Duluth, Minn., by James Gayley, first vice-president of the United States Steel Corporation, who is making an annual tour of inspection of the Lake Superior mines of the corporation. He said: "There is likely to be rapid development in the northern Minnesota iron ore region from this time on in electrical power. On the Mesabi Range there are some sixty to sixty-five shafts in operation for hoisting ore and pumping water, and there are still more steam shovels mining ore from open-pit mines, from stock piles, and stripping off earth overburden. All these are within fifty-five to sixty miles from the source of large power at Duluth, which can be easily and readily carried to them by wires. The recent great improvement in efficiency of electrical machinery and application, and in long-distance transmission makes it possible, it is believed, to substitute this power for steam, at a vast saving in operating costs.

"Electrical underground haulage systems are going in at several mines at the present time. This is no new experiment, for that system has been in use at mines of the Menominee and Vermilion ranges and in the Michigan copper country for some time and has proved its worth. But the system is on the eve of a wide extension. Long electrical haulage is under installation at this time at some of the Oliver Iron Mining Company's properties on the Mesabi Range, and is to be adopted at once at its and at other mines of the Marquette and Menominee ranges.

"Hoisting ore and pumping water by electricity are not yet adopted methods for the big mining regions of the Northwest. It must be remembered in this connection that what may have been tried and found successful in many mining districts is not necessarily possible for these Lake Superior regions, for on the lake we do things in a big way, and what might elsewhere be considered a success on a large scale would be with us but a mere experiment in a small way, a mere individual unit operation, as it were, that would not give us data upon which to judge general results. But the plan of a large electrical hoist is now under consideration for Mesabi Range plants, and may be adopted any day. It certainly will if the claims for savings and increased efficiency are substantiated.

"It has been doubted if steam shovels could be operated by electricity; they are moving machines and require power in a peculiar way. But the Oliver Iron Mining Company is now taking up this question, and in a few days may close contracts for dynamos and other electrical appliances to be installed upon one or two of its many shovels as test plants. There is no question of the enormous saving to be gained from these plants if the results are anything like what has been figured out by the engineers.

"The actual beginning of water-power development on a large scale at Duluth by the Great Northern Power Company will furnish at low cost the energy necessary for all this new work, and the elimination of coal fuel we hope to secure. The works of this company are going in at a rapid rate, and should be ready to furnish power in a year. There is from 50,000 to 60,000 horse-power in mines

of the Mesabi and Vermilion ranges, and more than that amount in the locomotives of the three roads bringing ore from these mines to the head of Lake Superior. If the time ever comes when this great energy can be generated by the rapids of the St. Louis River, rather than by the burning of coal, it will be something worth talking about."

Detroit Municipal Lighting.

Secretary Bowler, of the Detroit public lighting commission, has submitted his annual financial report for the fiscal year ending June 30. The report purports to show that the cash cost for operating an arc lamp was less last year than ever before, the alleged amount being $34.99, which is $5.17 cheaper than the previous year.

According to the report, the receipts for the year amounted to $211,152.43. To this amount are to be added the cash balances in the hands of the city treasurer and secretary on June 30, 1904, which amounted to $42,592.74, making the available cash for the year, $253,745.17. Disbursements for the year were $218,665.23, leaving a cash balance of $35,079.94 on June 30 last.

Investments for the year amounted to $91,523.48, making the total investment June 30, 1905, $899,717.53. Deducting 3 per cent for depreciation, makes the net investment show an increase over last year of $48,704.76.

Total cost of operating the plant was $121,380.41, which is $1,713.58 less than a year ago. The cost of operating the arc plant was $98,605.24, while $2,775.17 was paid out for the incandescent plant. The "cash cost" for each arc lamp was $34.99, showing a decrease of $5.17 per arc lamp from last year. During the year 408 additional arc lights were installed.

Manufacture of Artificial Abrasives.

Mr. J. H. Pratt has issued for the U. S. Geological Survey an interesting report on the manufacture of artificial abrasives for the year 1904, as part of his report on abrasive materials in general. We may quote him as follows:

The abrasive materials included under this head are corborundum, crushed steel, alundum (artificial corundum), and adamite. Of these artificial abrasives, carborundum and alundum are manufactured in the largest quantity and are of the greatest value. The total production of these artificial abrasives in 1904 amounted to 11,870,380 pounds, valued at $830,926, or over one-half the value of the production of natural abrasives, which was $1,406,851. The production of carborundum in 1904 amounted to 7,060,380 pounds, an increase of 2,300,490 pounds, as compared with the production of 4,759,890 pounds in 1903. This is the largest production in any year since the beginning of the manufacture of this abrasive and illustrates the increasing demand for it. With the exception of one year, 1902, there has been a continual increase from year to year in the production and use of carborundum, and in that year the decrease was due to a scarcity of supplies used in the manufacture of the carborundum. This increase in the production and use of carborundum is well brought out in the following table, which gives its production since 1892, when it was first put on the market. Its value now varies from 8 to 10 cents per pound.

Production of carborundum, 1892-1904.

Year.	Quantity. Pounds.	Year.	Quantity. Pounds.
1892	1,000	1899	1,741,245
1893	15,200	1900	2,634,900
1894	52,200	1901	3,838,175
1895	226,000	1902	3,741,500
1896	1,207,800	1903	4,759,890
1897	1,256,400	1904	7,060,380
1898	1,447,200		

The manufacture of artificial corundum from a bauxite which has been developed and put on a commercial basis by the Norton Emery Wheel Company, of Worcester, Mass., at its plant at Niagara Falls, N. Y., has met with great success, and this abrasive, which is known commercially as alundum, is giving most satisfactory results. The greater part of this material produced by the Norton Emery Wheel Company is used by the company itself in the manufacture of its various emery wheels, stones, etc. It makes a clean, fast-cutting abrasive, being nearly absolutely free from any kind of impurity, and has proved its excellent qualities in actual use

There is another artificial corundum that is being used as an abrasive, but it is only obtained in small quantity, as it represents a by-product in the Goldschmidt thermit process of the reduction of many of the metals. At the present time none of this corundum is made or put on the market in this country, but at the German factories where the Goldschmidt thermit process is employed it is utilized as an abrasive.

It is interesting to note the different colors of this corundum, according to the metal that has been prepared. Thus, in the reduction of the mineral chromite to metallic chromium, the corundum, which is the slag that remains, is of a ruby-red color, sometimes the crystallized portion being perfectly transparent; the nickel ores give a blue to bluish gray colored corundum; the manganese ores give a light, intense yellow to greenish-yellow corundum; and the titanium ores give a brownish to brownish-black corundum. The corundum obtained in this way is very pure, but somewhat different in texture and appearance from the corundum obtained by the reduction of bauxite by the Norton Emery Wheel Company, inasmuch as the latter shows little or no parting planes developed and breaks with an irregular fracture, while the former sometimes shows the parting planes well developed and at other times breaks with an irregular fracture.

In 1904 there were 4,020,000 pounds of alundum manufactured, only a small portion of it being put on the market in the crude form; it was sold at an average price of 7 cents per pound.

Fishing Made Easy.

The invention described below is hardly the idea of a sportsman, but according to the *Saturday Evening Post,* is effective for its purpose: The New York Aquarium, which is the largest and best equipped institution of its kind in the world, obtains its supplies of tropical fishes from the waters of Bermuda. Some of the rarest and most beautiful species are exceedingly hard to catch, persistently refusing to take a bait, and on this account it has been found necessary to resort to a very novel and ingenious expedient to effect their capture—an electrical contrivance, which serves to stun the coveted specimen and reduce it to helplessness until it can be made a prisoner. The device in question consists in part of a small and compact storage battery, which is held in a leather pouch beneath the arm of the operator, who wades as quietly as possible through the shallows and invades, with as little disturbance as may be, pools among the rocks. He carries a long-handled dipnet, to the handle of which a wire is attached. On the other end of the wire is fastened a percussion cap of the kind used for exploding dynamite cartridges. It is the bursting of the cap that is relied upon to stun the fish. Luckily for the hunter, fishes have as much curiosity as land animals, and even the shyest one will approach a bait to look at it, though indisposed to attempt the slightest nibble. Accordingly the percussion cap at the end of the wire is concealed either by something eatable or by a bunch of grass wrapped around it. Mr. Fish wonders what it is, ventures near, and has instant reason to regret his imprudence. The fisherman closes the circuit, the percussion cap is exploded, and the victim is rendered for the moment helpless, though receiving no permanent injury. Promptly, by reversing the dipnet, he is gathered in, and a few days later he finds himself swimming about in a tank.

Success in Electrical Salesmanship.

A little story in the *World's Work* for August will be of interest to many of the commercial readers of this journal. Possibly if the story is true—apparently the event is not recent—they may be able to identify the salesman. It is said that once a bright young salesman went into the office of a Memphis merchant to sell him a bill of carbons for his arc lights. He was conscious of having a distinct advantage in a carbon that he could sell at $11, for which his competitors were obliged to get $16.50. "You can't sell that carbon for $11, can you?" inquired the merchant. "Yes, sir; there is no mistake about it," quietly answered the young man. "If you feel any question about it just let me send you what you need, and if they are not all right in every particular you have only to notify me and I will come here personally and ship them back to the house."

"Well, on that understanding," returned the merchant, "you may ship me 5,000."

This time it was the salesman's turn to be astonished, for this was a sensational quantity for a merchant to buy for his own use.

"May I ask," inquired the young man, "how you are going to use so many?"

"Certainly," answered the merchant, drawing a set of contracts from a pigeonhole of his desk, "here are the contracts for a $15,000 light plant that I am going to put in across the street."

"Signed them?" inquired the young man.

"No; but I'm going to to-night," answered the merchant, "for I've threshed the details of this thing over until I'm sick and tired of them."

"Now," responded the salesman, "I've demonstrated to you that I can beat those people all to pieces on the price of carbons, and I give you my word that I can do the same thing on the plant that you propose to put in. Put off the signing of that contract until to-morrow night, get on the train with me and go to our plant in Chicago and I will show you that I can save you money on equipment."

The merchant finally agreed, with the result that the salesman who saw this opportunity sold the merchant a $15,000 plant.

CURRENT NEWS AND NOTES.

HOT ROLLS.—The presswork of one of the largest printing offices in New York City was threatened with complete stoppage during the recent hot weather by the inability of the pressmen to keep their ink rolls from melting. The situation was cleverly saved, however, by taking out some of the adjacent incandescent lamps and installing fan motors in such a manner that the breeze from them was projected directly on the deliquescent rolls. The currents of air thus obtained were sufficient to keep the composition firm and solid, and the rush of work at a critical moment was all cleaned up, not a single "token" being skipped.

OLD-TIME TELEGRAPHERS.—The twenty-fifth annual reunion of the Old-Time Telegraphers and of the Society of the United States Military Telegraph Corps will be held in New York City at the Waldorf-Astoria, August 29, 30 and 31 and September 1. Mr. John C. Barclay, general manager of the Western Union, is president of the Old-Timers, and Mr. W. B. Wilson, of Philadelphia, is head of the Society. The banquet will take place on Thursday, August 31. Business meetings will begin on Tuesday, the 29th. Numerous committees have been formed, including prominent telegraph men and others in Greater New York, and the outlook promises a large attendance as well as a most enjoyable convention.

ABANDONING THE THIRD RAIL.—With regard to its exposed or unprotected third rail, President Mellen, of the New York, New Haven & Hartford Railroad, has announced that the company intends to substitute the overhead trolley for the rail on its line between Hartford, New Britain and Bristol, Conn. The company had previously announced that it would return to a steam passenger service, which was strongly opposed by the cities and towns affected. It is also proposed to equip the Highland Division, between Hartford and Rockville, with the overhead trolley system for suburban service. The third-rail system is largely patronized and any one who sees the travel over it in this hot weather can readily understand why the local public does not want to go back to the regime of steam and its attendant discomforts.

NEW YORK LIGHTING COMMISSION.—Governor Higgins sent last week to the New York State Senate for confirmation these appointments to the State Lighting Commission: Frederic E. Gunnison of Kings, to be chairman; John C. Davies of Oneida, and L. L. Shedden of Clinton. The names of Messrs. Davies and Shedden had been announced previously with that of James R. Sheffield, of New York, who declined to serve. Mr. Gunnison is appointed to the vacancy created by the declination of Mr. Sheffield. All of the nominations were confirmed, but not until after a vigorous protest by Senator Grady, the minority leader, on the ground that the new commission was wholly partisan. Frederic Everett Gunnison, the chairman of the commission, is 36 years old. He is a native of Brooklyn. His father is the Rev. Dr. Alma F. Gunnison, president of the St. Lawrence University. He is a graduate of the New York University Law School, and is a practicing lawyer, a member of the law firm of Harris, Corwin, Gunnison & Myers, at 150 Nassau Street. Mr. Gunnison is serving his second term as president of the Union League Club, and also as vice-president of the Republican General Committee of Kings County.

THE COOL SUBWAY.—Although the heat in the Subway has been bitterly complained of, that "hole in the ground" proved last week during the hottest weather on record to be the coolest spot in New York. General Manager Hedley issued a statement showing the figures which had been reported to him by his employes. The test at City Hall Station, made at 3 o'clock in the afternoon, July 20, showed a temperature of 90° in the Subway Station, whereas on the street surface the mercury was at 100. At Thirty-third Street at the same time the Subway Station thermometer registered 87 as against 97° on the surface; Columbus Circle showed 90° in the Subway and 100° on the surface at 3 o'clock, while Sixty-sixth Street showed 87° in the station against 99° on the surface. The greatest difference was shown at the Ninety-first Street Station, where, at noon, the thermometer was 86° in the Subway and 104° on the surface, a difference of 18°. At noon the thermometer in the Seventy-second Street Station registered 89°, as against 97° on the surface. The Ninety-first Street Station registered 84° at 9 o'clock in the morning as against 98° in the street above. Throughout the hot period, according to Mr. Hedley, the temperature in the Subway has averaged from 5° to 14° cooler than it has been on the surface. To make a personal test of the atmospheric conditions in the Subway, President August Belmont of the Interborough Rapid Transit Company hit upon the idea last Wednesday, July 20, of holding a directors' meeting in the tunnel. At the same time a general inspection was made of the tunnel route. Instead of transacting business in a board room the directors went to the Bowling Green Station and there took a car, and while on the trip uptown discussed and acted upon various matters affecting the road. The question of ventilation was taken up and at the Brooklyn Bridge Station the directors left their car to inspect the work of the large rotary fans, two of which are being operated there. They can discharge Subway air into the street at the rate of 50,000 cu. ft. per minute. The location of two more of these fans was decided upon. When they have been installed the air at the big Bridge Station will be renewed every five minutes.

POOR WIRING.—In his presidential address before the Incorporated Municipal Electrical Association, Mr. F. A. Newington, chief electrical engineer of the Edinburgh Corporation, said: "The poor quality of the material used and the unsatisfactory way in which the work is carried out are certain to give trouble. So-called india-rubber insulation for electric conductors frequently contains from 50 per cent. to 60 per cent. of something that is not rubber at all. The elastic properties of this mixture soon disappear, and it becomes hard and brittle. If there is any moisture in the pipes the insulation fails, and then the house has to be re-wired. What will be the result of this? Will the consumer be content to be frequently having some of his lamps out of order, and after a period of, say, ten years find it necessary to re-wire his house? Will he not rather be inclined to think that electric light wiring and fittings are too uncertain and expensive to keep up, and so go back to some other form of artificial illumination? The material now very generally used for insulation is not nearly so good, on account of the high price of rubber, as that employed ten years ago. Contractors for electric installation work naturally buy the cheapest material they can, especially as competition in this class of work is very severe, but as a rule they have not any idea of what the insulation is composed of, nor have they the means of testing it. They simply trust to the makers of insulated cables to provide them with material that will pass the official test made by the Supply Authority. As iron pipes are now very generally used for protecting the wiring, a better insulation for the conductors is required than in the days when wood casing was practically the only material used. I do not suppose that the larger users of electric light would discontinue it on account of these troubles, as its convenience and other advantages will with them outweigh these, but to the consumers using only a few lights the expense of re-wiring their houses might be a very serious matter. As these smaller consumers are probably more profitable to us than the larger it will be to our advantage to do all we can to improve the existing unsatisfactory way in which this work is done."

NEW YORK CENTRAL TROLLEYS.—At Syracuse, N. Y., on July 22 Horace E. Andrews, of the New York Central-Andrews trolley syndicate announced that the syndicate had acquired the Rochester & Eastern Rapid Transit Railway, now in operation between Rochester and Geneva, via Canandaigua. The road has 65 miles of trackage.

BIG RUSSIAN SEARCHLIGHT.—A cable dispatch from Berlin of July 15 says: "The greatest searchlight in the world has been built here by Siemens & Schubert for the Russian Government. It is of 316,000,000 cp with a current of 200 amp. The reflector measures 6 ft. in diameter and the lamp's carbons are 6 in. in circumference. It is thought that the new searchlight is to be used in the port of Cronstadt."

AMERICAN AUTOMOBILE INDUSTRY.—Bradstreet's learns that there were produced by American makers in the calendar year 1904 about 17,500 automobiles, valued at about $22,000,000. Replies received from various offices of *Bradstreet's* in fourteen States of the United States show that there were produced by 100 manufacturers, in the fiscal year ending with June, 1905, 26,601 machines, valued at $34,650,500. Estimates of the capital employed in the production of these machines aggregate $21,313,000. These figures of output certainly make remarkable comparison with the figures of output given in the last census year of fifty-odd machines, valued at less than $60,000.

TROLLEYS IN BELFAST, IRELAND.—United States Consul Moe writes from Belfast, Ireland, as follows: "Large extensions are being made at the corporation generating station in Belfast for the electrification of the tramway system. A plant for 3,000 kw is being installed and about 40 miles of streets are in process of being equipped. The present capacity of the electrical works is 3,400 kw. The connections to the mains are equivalent to 197,000 8-cp lamps, including 2,100 hp in motors. The supply is by the three-wire, low-tension system, with 220 and 440 volts supply pressure. All the generators are arranged so that they can work on the lighting supply or on the traction system."

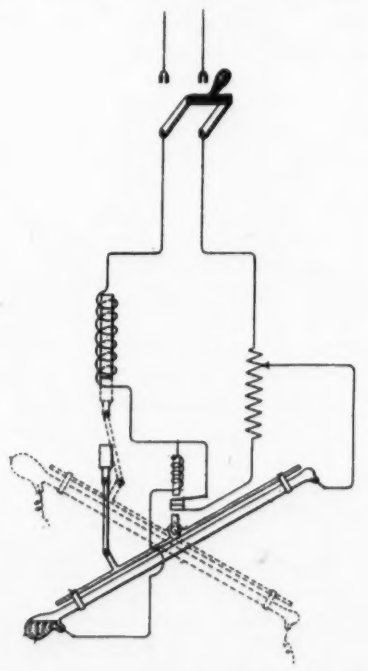
PROTECTION FOR PARALLEL-CONNECTED FEEDERS.—A patent issued July 18 to L. Wilson relates to protective devices for systems in which feeders are operated in parallel. In such systems, under normal conditions, the load is divided equally among the several lines. If, however, a short-circuit occurs on any one of the lines, that line draws an excess current. The inventor proposes to take advantage of this fact for cutting out the faulty line. Each feeder is provided with a switch operated by a differential device having two opposed windings, one of which is energized by the current in a single feeder, while the other winding is energized by the sum of all of the currents, the two windings being so proportioned that under normal conditions their effects are balanced.

IMPREGNATED CARBONS FOR ARC LAMPS.—For the purpose of increasing the efficiency of arc lamps, F. O. Vogel has devised a scheme for enriching the arc with metallic vapors and increasing the temperature of the arc, which scheme forms the subject of a patent issued July 18. The electrodes are provided with channels in which are contained the superoxide of natrium, calcium or barium, which is separated from a light-emitting material by the carbon walls of the electrodes. The superoxide is intended to supply ozone to the arc in order to increase its temperature. The light-emitting material may be lime, aluminum, barium oxide, the carbonates of potassium or strontium. Due to the presence of ozone the arc operates at a high teperature, and it is enriched with the vapors of the light-emitting substances. This action brings about an increase in the conductivity of the arc and in the radiation of light, which is carried to a still greater extent because the points of the electrodes become still more incandescent.

ARC LAMP WITHOUT FEEDING DEVICES.—On July 18 a patent was issued to M. H. Baker and S. P. Wilbur for an arc lamp whose electrodes are arranged concentrically one within the other. By constructing the electrodes in this manner and supporting them in such a way that they point in a downward direction, the arc formed between their lower ends will be so directed as to be blown downward, whereby the arc will be spread into a fan shape. It is evident that such a lamp will require no feeding mechanism. For use with alternating currents the wall of the inner cylinder will be made thinner than that of the outer cylinder, the cubical contents of the two being made equal for obvious reasons. When used with direct current the inner cylinder will usually be an ordinary carbon electrode. The outer electrode will, however, be impregnated and will constitute the positive electrode of the lamp. The proportions of the electrodes will be such that the consumption of each measured along its length will be equal to that of the other.

LIGHT AND POWER IN DUBLIN.—U. S. Consul Moe, at Dublin, Ireland, reports to the Department of Commerce and Labor as follows: "The lighting committee of the Dublin corporation has issued a report in which they recommend a reduction in the rates for general lighting and for the supply of current for heating and for motive power. In the case of general lighting, the rates are to be reduced on the maximum demand system from 14 cents and 5 cents to 12 cents and 5 cents. The committee do not recommend any reduction in the 12-cent flat rate, as in Dublin there is an undue proportion of offices and early closing shops which only use the current from four to five months in the year, and are not profitable even at the rate of 12 cents. For motors and heating current the rates are to be reduced from 14 cents and 2 cents to 8 cents and 2 cents, with an alternative flat rate of 5 cents per unit. The committee reports a steady increase in the demand for motor current though too small to be a satisfactory day load even for Dublin. They are completing an arrangement with one of the largest firms of motor manufacturers in the world for the adoption of a system of hire-purchase, under which motors will be supplied at very reasonable rates on the three-year installment plan. They believe this will satisfactorily affect the demand for power. Flat rates per unit are recommended for certain consumers who use current for a considerable number of hours each day. No concession is made to concert halls and other similar places of amusement, to 'temporary buildings,' or permanent buildings for 'temporary purposes,' or to churches and buildings attached thereto."

AUTOMATIC STARTER FOR MERCURY VAPOR LAMPS.—The diagram below shows a tilting device for mercury vapor lamps, as proposed by Dr. M. von Recklinghausen, in a patent issued July 18. The lamp, in the form of a long tube, is suspended so that in its inoperative position it will be tilted far enough to prevent connection between the electrodes through the mercury. By means of an electromagnet the lower end of the tube is lifted so as to cause the mercury to form a bridge between the terminals, and the tube is then

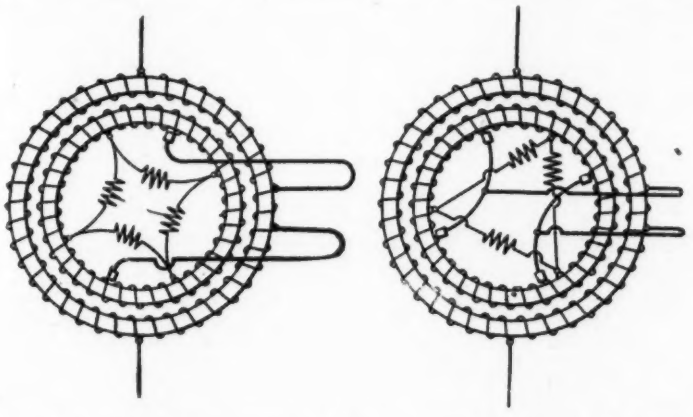


tilted still further to break the connection. The coil of the electromagnet, after doing its work of lifting the lamp, remains in series therewith as an inductive resistance. An auxiliary switch which serves for completing the circuit through the coil of the lifting magnet when the lamp is in its inoperative position, is opened when the lamp is fully tilted and the mercury vapor has been rendered conducting.

PRODUCING THE ORIGINALS.—A Parisian newspaper has been accused of publishing fake messages, and now comes to the front with the statement that the original of every telegram published will be displayed in its office window the day after publication.

COMPENSATED DIRECT-CURRENT DYNAMO.—In order to overcome the distortion of the magnetic field in the air-gap and pole face of direct-current machinery caused by the magnetic effect of currents in the armature conductors, F. A. Mott, according to a patent issued July 18, would divide the material forming the path for the magnetic lines in the field structure into a number of different magnetic circuits, and would arrange to excite each of these circuits independently. The object of this construction is to allow the density of the magnetic lines in different parts of the pole face to be varied as desired, so as to permit the brushes to remain in practically the neutral position at all loads.

REPULSION-INDUCTION MOTOR.—In a patent issued July 16 to M. Milch is disclosed a self-starting, single-phase commutator motor, which has a speed limit at or near synchronism. In construction the machine differs inappreciably from a repulsion motor. A slight change is made in the rotor winding so that points symmetrically located thereon are joined together through impedances. These impedances are highly inductive, but contain very little resistance. When the rotor is stationary very little current flows through the impedances and the machine receives its starting torque on account of its repulsion motor features. At synchronism, however, the rate of change of current through the impedances is zero,



and they act as low-valued resistances to short-circuit the rotor winding, which consequently becomes the secondary to the stator winding, which acts as the primary of a single-phase induction motor. In order to compensate for the exciting current of the induction motor, the circuit to the rotor brushes is opened and there is impressed upon them an e.m.f. of the proper value and time phase position. This e.m.f. is obtained from taps upon the primary winding, as indicated in the accompanying illustrations. At starting this small voltage is overpowered by the voltage induced in the rotor windings and the motor acts as though the brushes were short-circuited.

Electrical Engineers of the Times.—XX.

MR. H. H. CUTLER.

Harry Henderson Cutler was born at Brookline, Mass., 1859. He received his early education at the Boston English High School, and in 1881 graduated from the Massachusetts Institute of Technology in the department of mechanical engineering, and the following year took a post-graduate course at the same institution in civil and mining engineering. In 1883 he occupied the position of erecting engineer for the Southwark Foundry & Machine Company at Philadelphia, builders of the Porter-Allen high-speed engine, and the following year was with the Thomson-Houston Electric Company at Lynn, Mass. In 1885 and 1886 he was superintendent of the Citizens' Electric Light & Power Company of Akron, O., during which time he reconstructed the arc lighting plant. The company having been sued for heavy damages by the Central Telephone Company for disturbing its telephone service, Mr. Cutler rearranged the lighting circuits and succeeded in balancing them so perfectly that the Telephone Company withdrew its suit, accompanied by the statement that under the new arrangement it was impossible to tell by listening over the telephone whether or not the station was in operation. This work was done in the summer of 1885, and subsequently Mr. Cutler was retained by the Thomson-Houston Company as an expert to testify in various suits with the Bell Telephone Company.

In 1887 Mr. Cutler became superintendent of the Newton, Mass., Electric Light & Power Company, and in that year purchased for the company the first alternating-current generator built by the Thomson-Houston Company, which was set up in Newton in connection with an arc lighting plant. Shortly afterward Mr. Cutler conceived the idea of connecting incandescent lamps in series of 20 or 40 on 1,000-volt lines without the use of transformers, the same lines being used in connection with transformers for operating indoor incandescent lamps. Early in 1887 sixteen candle-power lamps were operated on this system five miles from a central station, and finally over 1,000 incandescent street lamps were installed in Newton. This system was adopted by the Thomson-Houston Company and quickly went into very extensive use. During 1889 and 1890 Mr. Cutler entered into the manufacture of electric street lighting fixtures at Waltham, Mass., at the same time doing consulting engineering work. He furnished all of the fixtures to the Thomson-Houston Company for the incandescent lighting system which he had developed, some of which are still in operation, not only in the United States, but in St. Petersburg, Constantinople and many other places in Europe. In 1891 he organized with Mr. George Cutter the Electrical Expert Company of Chicago. The following year he sold his interest to Mr. Cutter, and in 1893 organized the Cutler-Hammer Manufacturing Com-

H. H. CUTLER.

pany. For the first seven years of this company's existence he designed all of the apparatus it manufactured. He acted as treasurer and engineer of this company from 1893 to 1898, and in the fall of 1896 purchased the controlling interests and became its president. In 1898 the company was reorganized and the following year the entire plant was removed to Milwaukee.

Mr. Cutler has taken out more than 40 patents covering various electrical devices, most of which are now being manufactured by the different companies with which he is connected. Among the recent inventions covered by these patents are a magnetic accelerator, a single-wire system for operating trains of cars and a single-phase system for operating trains of cars over long distances, using single-phase induction motors. While acting as superintendent at Newton, Mass., he designed and constructed the entire plant at that place, obtained the contract for the lighting of the streets and had an ordinance passed allowing the wires to be run within 15 feet of the ground when desired. The problem of wiring the city of Newton was considered at that time a commercial impossibility on account of the great number of very high trees. To overcome this difficulty Mr. Cutler conceived the idea of constructing ornamental hard pine poles and running wires under the branches of the trees, instead of over the trees, which plan was quickly followed by other cities.

Mr. Cutler is vice-president and chief engineer of the Cutler-Hammer Mfg. Co., a million-dollar corporation, and also vice-president and chief engineer of the Cutler-Hammer Clutch Company, which manufactures the new type of magnetic accelerator, or clutch of his design above noted. He is a ember of the A. I. E. E. and of the Chicago Electrical Association.

Electrical Power Development at Portland, Ore.

THE Northwestern Gas & Electric Company has completed one of the most difficult tasks in electrical engineering by construction of its power plant and reservoir in Umatilla Co., Ore. Water is taken from the Walla Walla River, and carried over canyons and hills in a 48-in. wood stave pipe a distance of 29,000 ft., to a reservoir on a mountain side, whence it falls 356 ft. to the wheels. The construction was very expensive, as there was a great deal of excavating for the bench on which the pipe is carried, and there were many trestles across deep canyons. Some of these canyons are crossed by use of inverted syphons. Several of them have 170 ft. head. The plant is now in operation and a complete success. It furnishes light for the cities of Pendleton, Walla Walla, Weston and Athena, and power for driving flouring mills and other industries. The plant develops 3,000 hp. The company will build an electric road at Walla Walla, tapping suburban points. The most serious problem in construction was the handling of materials. The site was a long distance from a center of supplies, and there were no means of transportation. Much of the materials had to be hoisted with donkey engines to points along the route of the pipe line, and to the reservoir site, owing to the precipitous character of the country.

By the end of the year 1905 the 12,000-kw of electrical power now driving the street railways, interurban electric roads and other industries in and around Portland will have been increased to 30,000 kw, and in addition there are other important electrical plants now in operation that were not running a year ago in Oregon. This State has vast water powers, originating in streams that rise in the Cascade and Coast Ranges and flow through every part of the State, offering an immense field for electrical development.

The Portland General Electric Company was organized in 1892, and shortly thereafter acquired the valuable water power and canal companies at Oregon City, together with all of the electric light and power companies operating in and about Portland and Oregon City, Ore. The company does the entire public and commercial electric light and power business of the City of Portland and surrounding territory, with a present estimated population in excess of 135,000, and in addition supplies the city street railway system with the greater part of its power.

Portland is a substantial, well built and conservative city, and, as will be seen by the following, is rapidly increasing in population:

Year.....	1890	1900	1905
Population.....	46,385	90,426	125,000 (estimated)

The city is located at the head of deep water navigation on the Willamette River, near its confluence with the Columbia River, and is the business centre of the Willamette Valley, a large and very fertile valley about 170 miles in length, noted for its great productivity and agricultural resources. Portland is an important railroad centre, being the terminal point of the Northern Pacific, Oregon Short Line (Union Pacific) and Southern Pacific Railroads, and has a very large jobbing and wholesale distributing trade throughout the State of Oregon and other adjacent districts. It is also a prominent export point for wheat, lumber and their manufactured products and is fast becoming a manufacturing district of importance, having large lumber and flour mills, machine shops and miscellaneous manufacturing establishments.

It is estimated that over one-third of the standing timber in the United States is located in Washington and Oregon. Immense fisheries and vast deposits of coal and iron add to their natural resources, and foster large manufacturing industries. No State in the Union exceeds Washington in the yield per acre of wheat and several other cereal crops. It is apparent, therefore, that although the States of Oregon and Washington have shown almost phenomenal growth, they have as yet scarcely begun their development. Rich agricultural land and vast mineral resources, together with abundant water power, will give them great industrial activity, while three continental railroads and excellent harbors, commanding as they do the oriental trade, assure them a place among the most important commercial States in the Union, and it is but reasonable to believe that Portland, by the census of 1900 their largest city, will continue rapidly to increase in population and commercial importance.

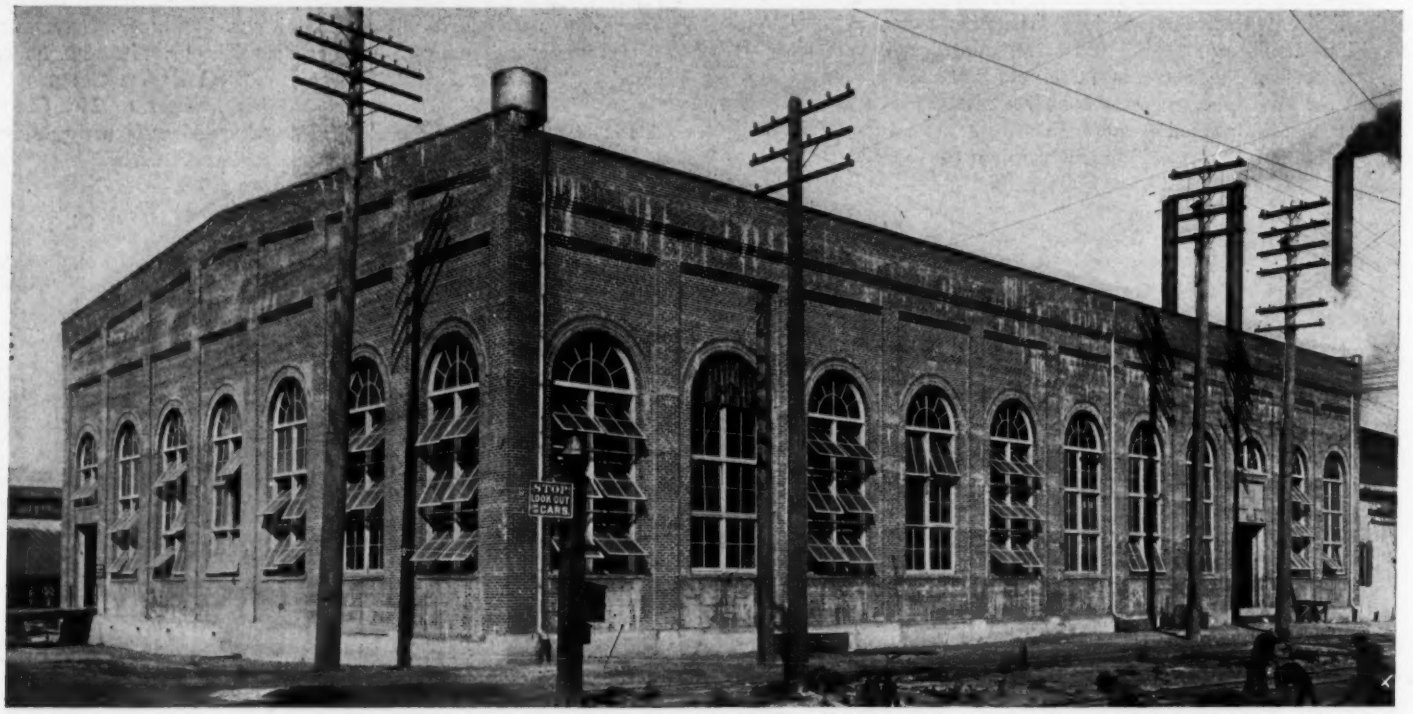


FIG. 1.—STATION E, PORTLAND GENERAL ELECTRIC COMPANY.

The generating plant of the Portland General Electric Company consists of two principal stations, one located at Oregon City, about fourteen miles from Portland, and operated by water power from the falls on the west bank of the Willamette River, and the other a large new steam plant fully equipped with modern steam engines of both vertical and turbine types, situated in the city of Portland.

The present installed machinery capacity of the water power plants is 8,600 electric horse-power, and of the steam plants 10,000 hp, or a total of 18,600 electric hp. The company's ability to derive a large percentage of its power from water, enables it to generate current at minimum cost. During the last two years the company has expended nearly $1,000,000 in increasing the capacity of its plants and in the unification and improvement of its water and steam units, sub-station and distributing systems. The physical property of the company is of a high standard, much of the equipment having been recently installed. As soon as occasion requires, it is proposed to construct another water power plant on the east bank of the river at Oregon City, of an ultimate capacity of 30,000 hp.

FIG. 2.—INTERIOR OF PORTLAND GENERAL ELECTRIC NEW STATION.

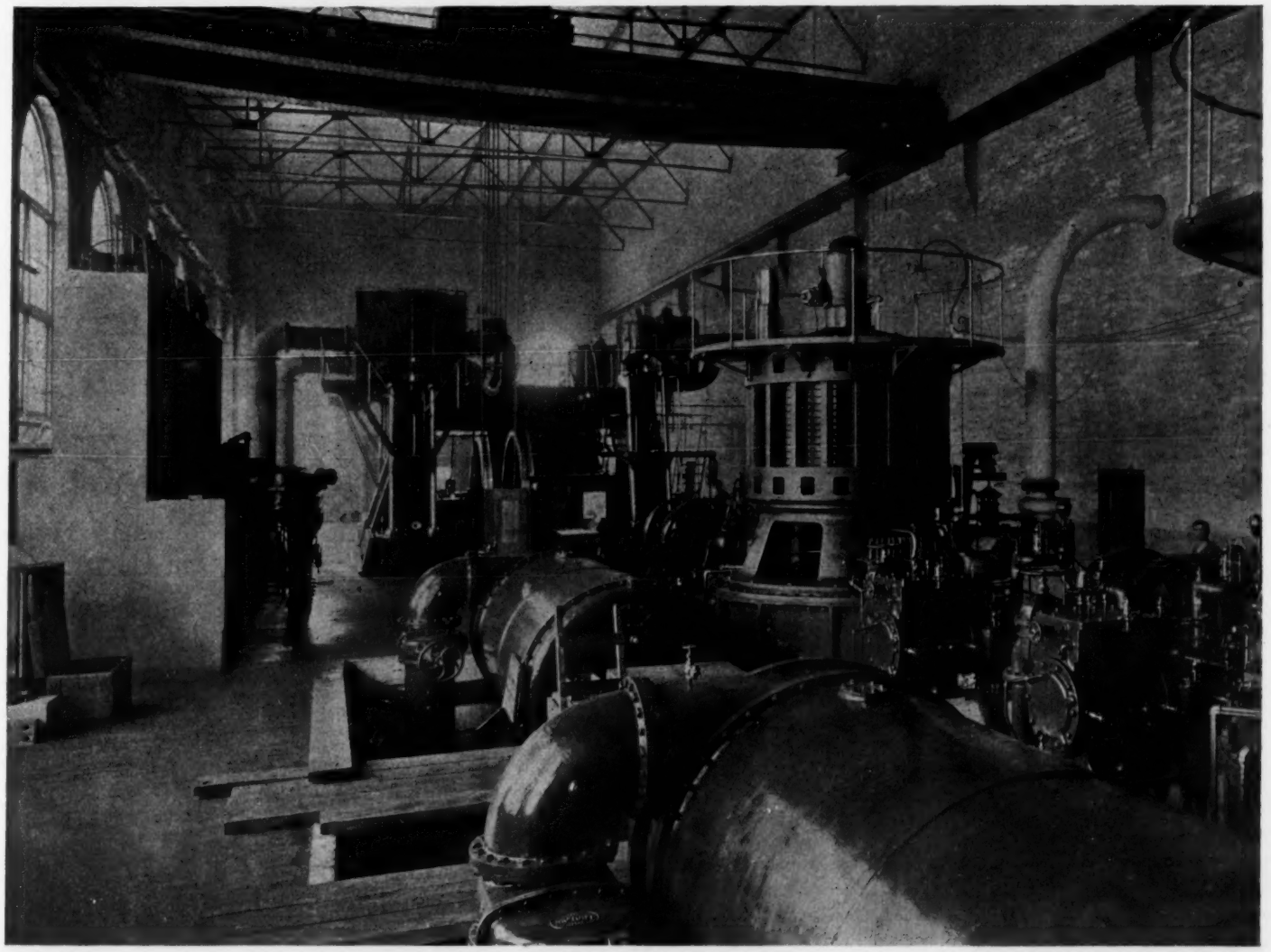


FIG. 3.—INTERIOR OF PORTLAND GENERAL ELECTRIC NEW STATION.

The company furnishes about 3,000 kw of the power necessary for operating the Portland Consolidated Railway's 120 miles of electric road; for driving the Portland Flouring Mills, the largest on the Pacific coast, and a part of the power for operating the 100-mile system of the Oregon Water, Power & Railway Company's interurban road connecting Portland, Oregon City, Canemah and

FIG. 4.—CLACKAMAS RIVER AT DAM FOR CAZADERO PLANT.

Cazadero; and it also furnishes the public and private lighting for the city of Portland.

In this connection it would be interesting to state that an order has just been placed for a new street lighting system for the city. This system has been under test for several months and the results show that when it is installed in permanent shape, Portland will be by far the best lighted city in the Northwest. The system referred to is that employing magnetite lamps, supplied with direct current secured from mercury-arc rectifiers and constant-current transformers, direct from the three-phase, 33-cycle, 10,000-volt, primary transmission system.

The new steam station above referred to as fitted with modern generating apparatus, is located in Portland, on the Willamette River, from which it secures an abundant supply of water for condensation purposes. Owing to the very great rise and fall of the river during times of freshets, when the waters of the Columbia River back up, thereby increasing the water level at Portland about 25 ft., special provision had to be made for supplying condensation water. A large water-tight, concrete pit (60 by 20 and 30 ft. deep) was built, and in this and at the level of low water, were placed engine-driven centrifugal turbine pumps, this arrangement at all times insuring a steady supply of condensing water, independent of the river level. The change of this river level of about 25 ft. is expected each year, and the shipping district along the river front provides two-story warehouses and docks for the handling of their business. During the high water period all business is done from the upper floor of the docks and warehouses, and during low river period from the lower floor.

The station building is of brick with concrete floors and iron truss roof and is practically fireproof. As the plant is in the neighborhood of sawmills and frame buildings, special provision has been made to guard against fires from the exterior by means of water tanks, fire pumps, etc

The boiler plant consists of five batteries of Cahill water-tube boilers, each battery rated at 1,040 hp, with a concrete and steel stack 230 ft. high and 12 ft. inside diameter; two 1,400-hp marine type vertical compound engines built by the Willamette Iron & Steel Company, each engine direct connected to a 1,000-kw generator; one Ideal engine exciter of 85 kw capacity; two Curtis steam turbines, each rated at 1,500 kw.

Provision is made for the operation of the plant by the use of sawdust from one of the large lumber mills or by fuel oil, and the change from saw dust to fuel oil, and vice-versa, can be made so quickly that it is unnecessary to extinguish the fires or to reduce the steam pressure on the boilers.

The larger part of the current is generated at 11,000 volts, three-phase, 33 cycles, which is the same type as that supplied from its station at Oregon City.

The power from both the hydro-electric plant at Oregon City and the steam plant at Portland is delivered to a sub-station located in the center of the city. This sub-station contains rotary converters static transformers and motor generator sets by which the energy is prepared for distribution either in the form of direct current 550 volts for the railways or 2,300-volt, 60-cycle current for general distribution. Very large customers such as the Portland Flour Mills, etc., are supplied direct from the 10,000-volt, 33-cycle transmission system. The capacity of the substation is about 10,000 kw. The company a year ago entered into a contract with the Lewis and Clark Exposition to furnish 100,000 incandescent lights for illuminating the fair. Construction of the Fair Sub-station was immediately begun, and the fair is now being lighted therefrom. The current is three-phase,

FIG. 5.—POWER PLANT AT WILLAMETTE FALLS.

33 cycles, 10,000 volts, and is carried to the sub-station and changed by static transformers to 2,300 volts for lighting.

After January 1 the Oregon Water, Power & Railway Company, which now buys a part of its current from the Portland General Electric, will sell power to the latter company. The Oregon Water Power & Railway Company is nearing to completion a power plant on the Clackamas River, 40 miles from this city, that will generate 20,000 hp, and the e.m.f. will be stepped up to 34,000 volts

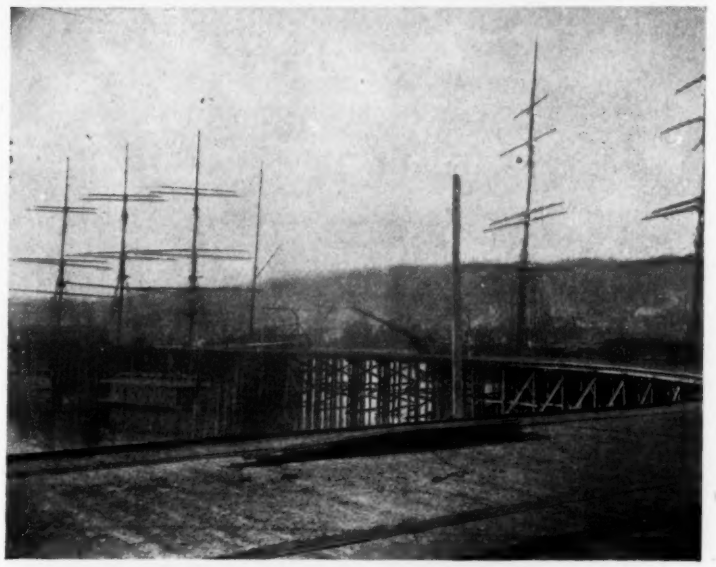


FIG. 6.—TERMINALS AND DOCKS ON WILLAMETTE RIVER, PORTLAND.

for transmission to Portland. The company is expending about $800,000 in erecting its new plant. Half a dozen generators will be installed, each of a capacity of 2,500 kw. Three pole lines will be run to this city, for railway feeders, trolley and high tension, respectively. The company will this year build an eight-mile extension of its line to Troutdale, on the Columbia River, and establish a ferry across the Columbia to Clackamas, in Washington, for passenger and freight traffic. Power will also be sold to the Oregon Traction Company,

FIG. 7.—HOGAN'S CANYON SIPHON, WALLA WALLA.

which is building an electric road from Portland to Forest Grove, 26 miles.

The character of the country through which the Clackamas River runs is rugged, and heavily timbered with fir and pine. The banks are precipitous, and the soil is gravel and heavy boulders. The company has riparian rights 2½ miles. It has constructed a timber dam to form a reservoir, from which the water is taken 4,000 ft. in a canal 60 ft. wide and 5 ft. deep, and dropped 125 ft. to the wheels. The water returns to the river. The company purposes to erect another dam and canal, and repeat the operation some time in the future, doubling its capacity to produce electricity.

Meteorology and the Dynamo.

BY M. I. CROMACK.

Meteorologists are agreed that electricity has much to do with atmospheric conditions, but they cannot in the present state of the science explain in precisely what way this influence is exerted. They know, however, that the crust of the earth and its gaseous envelope are constantly traversed by electrical currents, or dominated more or less by a variety of electrical manifestations. Familiar among these are the awe-inspiring electrical displays witnessed during the prevalence of a thunder storm, and the less frequent but more beautiful exhibitions of electrical energy in connection with the Aurora Borealis.

The identity of lightning and electricity was conclusively proven years ago by the famous kite experiment of the philosopher, Benjamin Franklin, and that the Northern Lights is an electrical manifestation is amply proved by the effect produced upon the mariner's compass and the sensitive apparatus of our telegraph and telephone systems. But even in the absence of these especial exhibitions of electrical energy the testimony of modern testing and measuring instruments proves conclusively that there is no time when earth and air are not saturated, so to speak, with electricity, or when the presence and effects of electrical energy are not plainly manifest.

Heat, light and electricity are doubtless the triune energies that dominate the universe. They are evidently but different manifestations of the same force which seems essential to the propagation and maintenance of all forms of life.

All human inventions are based on some particular phase of natural law. The inventor merely takes advantage of some peculiar attribute of matter, or some especial manifestation of natural force of energy, and bends them to do his will. He can neither create or destroy matter or energy. He can only divert them momentarily from their natural purpose, and by the adoption of adequate means compel them to do his bidding.

Human interference with the natural laws governing the propagation of animal and plant life may be made to produce marked variations in species, and fruits and flowers. Failure to obey or positive infractions of the laws of nature in the realms of hygeia, invariably entail discomfort and distress, if not disaster and death. Chemists tell us that a merely nominal change in the constituents of our mundane atmosphere would render it unfit for respiration, or the support of either animal or vegetable life. Minute changes in other elements, or in the conditions under which we exist, would doubtless be productive of ills innumerable. Light, heat and electricity are doubtless mainly instrumental in the production and stability of conditions favorable to the perpetuation of life as now developed on our planet, as long at least as they perform the duties assigned them by the Creator. But may not even minute interference with the natural performance of those duties be productive of evil?

Since the invention of the dynamo, electric light and power systems have grown and multiplied with phenomenal rapidity, and they are still growing and multiplying with constantly augmenting extent and volume. At the present writing the exploitation of such systems has become world-wide, and there are but few communities in civilized, or even in semi-civilized countries, that cannot boast the possession of one or the other.

The dynamo cannot create electric force or energy, any more than the boiler alone can create steam. Steam results from the combustion of fuel, which releases energy stored away by the sun ages ago. The dynamo merely diverts from its original purpose and turns into new channels electrical energy which has also, perhaps much more recently, emanated from the great orb of day—energy which but for the interference of the dynamo would doubtless have performed other and perhaps more important duties than the production of artificial light, heat and motion.

Up to the present time this interference of the dynamo with the electrical economy of nature, has not been of sufficient magnitude to produce evident effect. But may not the constantly increasing volume of electrical disturbances produced by the rapidly augmenting number and power of such machines, eventually bring about a disturbance

of the electrical equilibrium that will result disastrously to animal and vegetable life? May not the delicate balance of our mundane atmosphere, or the meteorological conditions that control temperature and humidity, be so disturbed that cyclonic storms and cloudbursts, hurricanes and floods, unprecedented variations in temperature, and other climatic perturbations may be produced to the serious detriment and discomfort of mankind?

Our beneficent central luminary is constantly shedding on his attendant satellites the energy which their wisely constituted atmospheres transform into heat, light, electricity, magnetism and motion, with the results that our globe, at any rate, is fitted to be the abode of highly organized and rational beings. Like the dynamo of the power house, the sun may be a perfectly cool and non-luminous sphere, the tenuous ether pervading all interplanetary space, equally cool and non-luminous, the conductor, and the mundane and planetary atmospheres the media for converting the solar emanations into the five modes of motion or forms of energy put forth by the dynamo. All of these manifestations of energy are appropriated to a greater or lesser extent by the power-driven dynamo in obedience to man's behest, and to minister to his comfort and pleasure.

Is it not possible that these inroads upon natural force and energy —this wresting of nature's energies from their legitimate channels— may eventually assume such proportions as to justify a note of warning? What may be the result of this disturbance of the electric balance of the world—this constant harrowing of the bosom of mother earth; this continuous agitation of the atmosphere by the constantly augmenting output of the light, heat, power and wireless telegraph dynamos—no one can foretell. What, if any, effect is being already produced upon meteorological conditions is left for the investigations of the electrician and the meteorologist.

Massie System of Wireless Telegraphy.

BY A. FREDERICK COLLINS.

IN striking contrast to the majority of patents issued in the class of wireless telegraphy are those granted to Walter W. Massie, of Providence, R. I., for instead of covering claims of a theoretical and even an imaginary nature, these patents relate exclusively to workable apparatus.

Different from nearly all other inventions in this line, Massie designs, builds and operates his electromechanisms first and then applies for governmental protection. If this mode of procedure were adhered to by his contemporaries, the number of patents would probably be reduced nine-tenths and transmission would be improved some 50 per cent.

In the apparatus to be described the chief features relate to the receptor and a controlling device for switching in and out simultaneously and with a single movement the bell alarm, the oscillophone, the transformer and the motor-generator, the connections of which are shown schematically in Fig. 1. The transmitting arrangement presents no new principles, but follows the specifications of the most recent practice. In sets built for one hundred miles and under the induction coil is utilized, but for transmission over greater distances the initial energy with which the transformer is supplied is taken direct from the street mains, or there is employed a small unit producing 25 amp. at 120 volts. In the first case, if the current is direct, it is converted by a motor-generator into a single-phase, 60-cycle current. The primary of the transformer takes 110 volts and the secondary delivers at its terminals the equivalent of 2.5 kw at a pressure of 60,000 volts. With this high tension there is charged a battery of adjustable plate glass condensers, which, disrupting the spark-gap, sets up the desired oscillation in the radiating system.

An objection to which all receptors employing a telephone receiver as a translator of the impressed oscillations have been subjected lies in the fact that the operator must either keep the 'phone to his ear all the time or frequently lose messages in part or in whole. The usual method for circumventing these conditions is by having the operators set a predetermined time when both shall be at their posts and the telegrams are to be transmitted.

This arbitrary and limiting scheme has been largely responsible for the ban that has been put on this type of receptor, and Massie has made a decided improvement by introducing what should have been done long ago, namely, a bell alarm. Naturally, an alarm demands the use of a filings coherer, and having the latter to contend with it may be asked why its functions should not extend a step further and a Morse register be operated. The reasons may be given in triplicate: since an apparatus merely for signaling and not the alphabetic code entails no such careful adjustment as those for recording intelligence, the sending can be greatly increased in speed, and atmospheric disturbances considerably diminished.

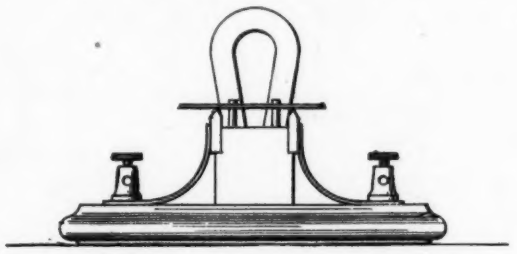


FIG. 2.—END VIEW OF THE OSCILLOPHONE.

The oscillophone, as the inventor has named his receptor, employs an improved form of microphonic contact and a telephone receiver. Its connections with the aerial and ground circuits through the medium of the controlling switch are graphically brought out in the diagram of Fig. 1.

An end view of the oscillophone detector is shown in Fig. 2. This wave responsive device is mounted on a base made of a suitable insulating material, which also constitutes a support for the terminals of the instruments; on this base is mounted a block of hard rubber or slate, the opposite sides having rabbets to receive the carbon terminals of the microphonic detector. The carbons are flat and are about 3 cm. in length, 1 cm. in width and 3 mm. in thickness; these are held in operative relation to each other by bowed springs, which also serve as conductors. The lower ends of the springs are attached to the binding posts to which the oscillophone is connected into the local circuit. The terminals are of a composition of carbon and heavy oil, the upper surfaces being ground to knife edges.

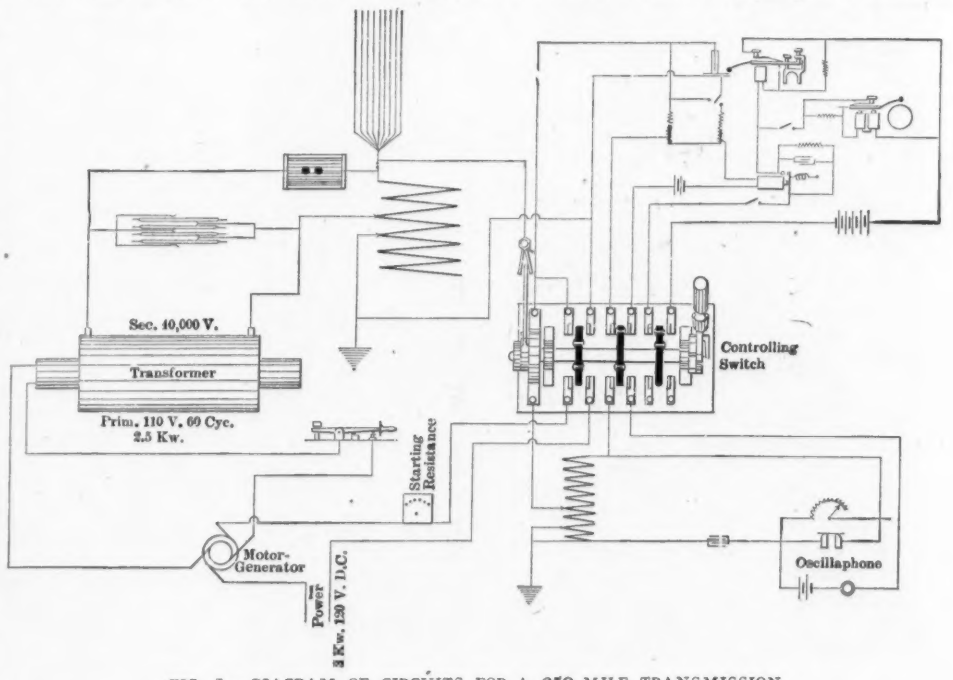


FIG. 1.—DIAGRAM OF CIRCUITS FOR A 250-MILE TRANSMISSION.

In preparing the edged terminals the carbon is ground up and mixed with heavy oil in suitable proportions to make a plastic mass, after which it is moulded in the desired form and then baked. A terminal conductor thus prepared possesses eminently satisfactory

characteristics, in that it presents an anti-friction surface to the conducting bridging element or needle extending across the gap between them.

The bridging element for the terminals is made of steel, although some of the other metals have been found to work satisfactorily; steel is eminently adapted for use in the oscillophone detector, since it is possible to hold the needle against accidental displacement on the carbon knife edges by magnetic attraction; a permanent magnet of the familiar horseshoe type is so placed that its legs may be adjusted perpendicularly to the base, so that the lines of force through the bridging element may be made to act as strongly or weakly as desired. Its purpose is to sustain the position of the needle on the carbons magnetically, but absolute contact between the element and the magnet is effectually prevented by metallic stops, which project above the knife edges.

In the ordinary forms of microphonic wave detectors, the bridging element is subject to vibration, and under the action of the local current has a tendency to roll from place to place on the carbons, which not only impairs its efficiency, but renders the readings of the instrument inaccurate; in fact, these are the things that have prevented the extended use of the microphone detector heretofore.

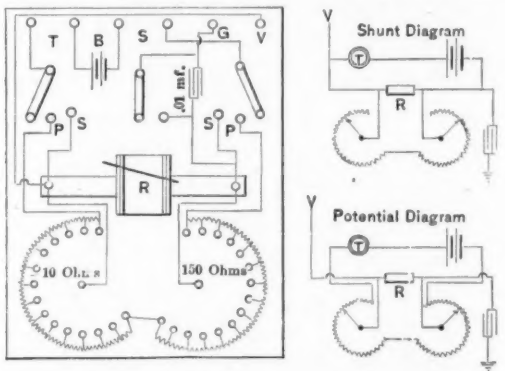


FIG. 3.—DIAGRAM OF OSCILLOPHONE CIRCUITS.

In the Massie oscillophone the needle is drawn gently to the pins and is held firmly against the edges of the carbons, and in this way the prior sources of trouble have been eliminated and, at the same time, its sensibility is increased many fold.

A diagram of the oscillophone circuits is shown in Fig. 3, while a photographic view of the oscillophone is given in Fig. 4. The detector of the oscillophone has a normal resistance of approximately 40,000 ohms, which, after cohesion is effected, drops to less than 700 ohms. The potentiometer, which is divided into two parts, is wound for 10-ohm and 150-ohm steps, respectively, and a condenser

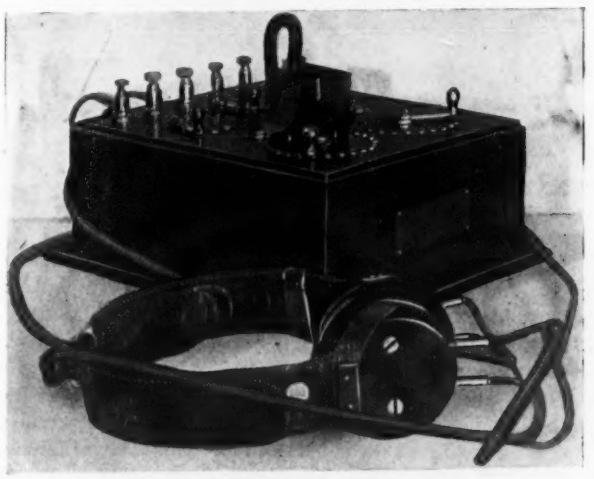


FIG. 4.—OSCILLOPHONE COMPLETE.

of .01 microfarad is connected in series with the earthed terminal, and thence through the system to the vertical wire. There is provided a switch to cut in and out the condenser. The oscillophone may be connected either in shunt or for potential, as the smaller diagrams in Fig. 3 illustrate. Either of these circuits may be used at will by means of the switches, the terminals marked *P* and *S* indicating potential and shunt respectively. The former is used for long-range and the latter for short-distance work.

In a separate circuit, cut in and out by the controlling switch, is the bell alarm for ringing up the operator. This adjunct comprises a modified form of coherer, a tapper, relay and bell. The novel feature of this arrangement is the coherer, the object of which is to facilitate cohering and thus increase the sensitiveness of the device. Coherers using a magnetized steel needle imbedded in the filings have been experimented with in the past, but in all devices prior to the one here described the oscillations had to cohere the whole mass of filings and overcome as well the weight or force of gravity on the filings in order to form a conducting bridge; further, in coherers of

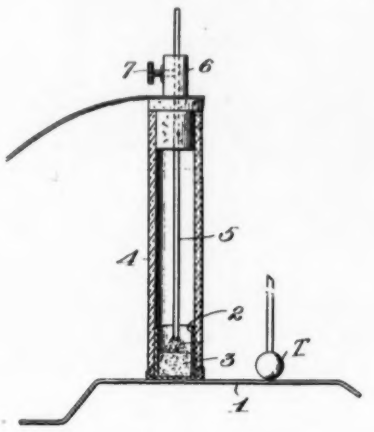


FIG. 5.—MASSIE COHERER.

this type the tapper must strike blows of considerable force to decohere the filings, while in practice these requirements decrease to no small extent the sensitiveness of the coherer.

To obviate these tendencies Massie has designed a coherer in which the magnetized needle is supported with its end out of or free of the non-magnetic filings as distinguished from being engaged with a mass of filings. In the cross-section shown in Fig. 5 a strip of metal, 1, constitutes one terminal of the coherer and supports a cup, 2, also of metal, which serves as a conductor, 3, as well as to contain a mass of silver or other non-magnetic filings; the containing cup is secured within the glass tube, 4. The magnetized needle, 5, may be adjusted in the collar, 6, and its position fixed by the screw, 7. In the diagram the letter *T* designates the tapper, which is of the usual electromagnetic type.

The mass of filings, 3, is placed in the cup, 2, and then the magnetic filings are put on top or superimposed so that when the needle is adjusted in proper proximity thereto the magnetic filings are attracted and held up by the needle and just in contact with the mass of filings in the cup. The magnetic filings are thus cohered at all times, leaving nothing for the oscillating current to do but to cohere the magnetic to the non-magnetic filings, the line dividing them constituting a surface having a multitude of small faces to facilitate the cohering action.

The non-magnetic filings may be of silver, nickel or other metal, and the magnetic filings are preferably of soft Norway iron. The difference in the structure of these metals gives rise to numerous sharp edges and minute forces forming an imperfect electrical contact having an infinitely thin insulating film of air between them. The effect of this superimposing the two different kinds of filings in a line at right angles to the surface of the earth is to produce an effect of cohesion by the electric oscillations and forces of gravitation in identical direction. For this reason it is obvious that the energy necessary to break down the minute air films and weld the edges of the filings together is much smaller than in coherers where the conductor plugs are parallel with the earth's surface.

The current in this coherer need not be directed through the magnetic filings, the surface presented by the top layer of such filings and the sides of the cup acting as conductors; further, the mass of non-magnetic filings shown in the drawings need not be, and, in fact, is not cohered, the cohesion of the magnetic filings to the many-faced surfaces being effected by the top layer of the non-magnetic filings, so that the oscillations have materially less work to perform than in other detectors that have sought to aid cohesion by magnetism. Fig. 6 is a photographic reproduction showing the magnetic coherer and bell alarm attachment, and Fig. 7 illustrates the coherer used in connection with a Morse register.

In his letters patent specification No. 787,780, Massie describes a

very ingenious switch-controlling mechanism that is a wonderful improvement over the plugs formerly used and the multipole, double-throw switches that are now a familiar adjunct of every system. The advantages of the controlling switch will be apparent by referring again to the diagram (Fig. 1). Here it will be readily observed that the many different circuits are open and closed in se-

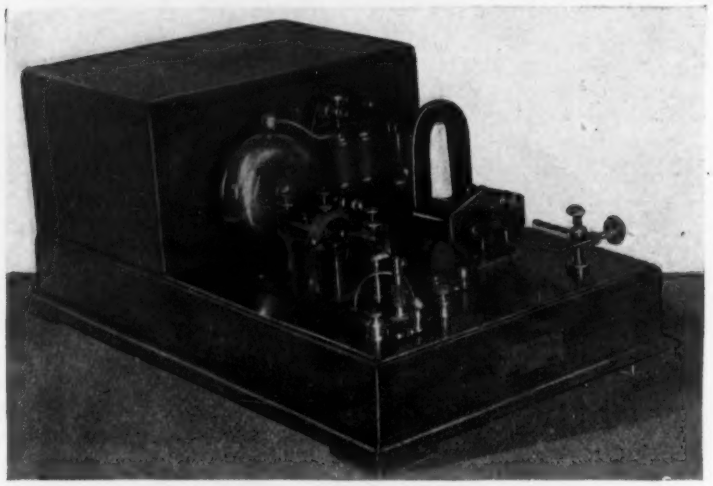


FIG. 6.—MAGNETIC COHERER AND BELL ALARM.

quence by a single movement of the lever. These circuits include those that carry the low-voltage, direct current of the motor and high-tension oscillations of the radiating system, and those operating the bell alarm, oscillophone and high-frequency currents set up in the resonator.

The sectional front elevation (Fig. 8) and the photograph (Fig. 9)

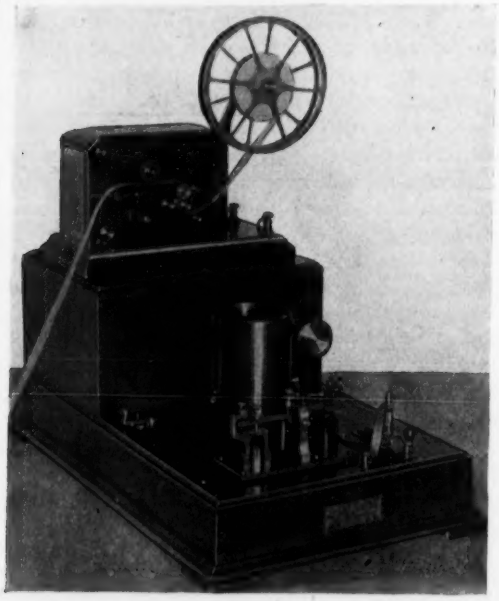


FIG. 7.—MAGNETIC COHERER AND MORSE REGISTER.

will serve to render its construction and operation apparent. The mechanism is mounted on a hard rubber block, and on opposite sides there are two rows of binding posts. Mounted rigidly on the bed are bearings supporting a rock shaft; over the rock shaft and between the bearings is an elongated sleeve made of brass; the shaft and sleeve are associated so that their turning movements are in unison. A peripherally indented disc, 22, is rigidly connected with one of the bearings, 18, and to one end of the shaft, the latter being attached to the hub of a hand lever, by which the rock shaft can be turned to bring it into three different positions. The lever is provided with a spring pawl, the effective portion of which is adapted to be thrust into any one of the three peripheral indentations in the disc 22 by the action of the spring of the pawl in order to positively but yieldingly maintain the shaft in its three positions.

The tension of the spring prevents the hand lever and shaft from accidentally shifting, though permitting them to be easily manipulated by the operator. Rigidly fastened to the sleeve are three discs made of a non-conducting material; these discs are arranged to turn between the contact strips, a view of which may be seen in Fig. 1, and which are connected to the binding posts.

By turning the lever carrying the rock shaft, twenty-three different combinations can be secured by causing the three circuit closers or bridging devices alluded to to extend across and in contact with the upper sides of the several perpendicularly disposed contact strips. Movably connected with the shaft outside of the contact wheel, 28, is the hub of a knife; the hub is loosely carried by the shaft to

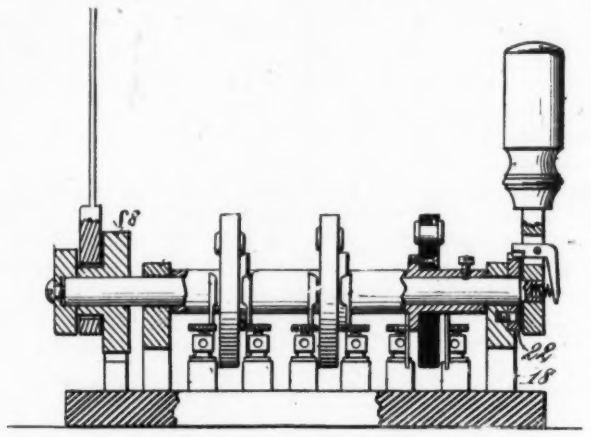


FIG. 8.—DETAILS OF CONTROLLING SWITCH.

secure a relative motion between the knife and shaft, the knife constituting a circuit controller.

From the above statement it will be apparent that when the sending circuit is closed ready for use both receiving circuits are open and grounded so that no injury can result to the operator or to the receiving instruments. By means of this arrangement the entire system is controlled by a single device and to change from the sending

FIG. 9.—CONTROLLING SWITCH.

to the receiving circuits or vice versa a single movement is all that is required; in this way the speed in operating is greatly accelerated and its rapidity is comparable with the wire system of Morse.

The first practical installation of the Massie apparatus was at Block Island and Point Judith, where it replaced one of the older and better known systems. A more recent installation was made at Wilsons Point, a shore station, to be used in conjunction with the boats of the New York, New Haven & Hartford Railroad. The Massie system has been in the service of the company cited for over a year, and has been highly satisfactory to all concerned.

The sensitiveness of the oscillophone has been frequently tested by the operations at the Block Island station, where messages in times past were picked up the moment they commenced to signal to the Nantucket Shoals Lightship, 90 miles to the east of Block Island; then assuming the ships were working a distance of 60 miles, the message-bearing electric waves traversed 150 miles to the Rhode Island coast, where they were received and translated by the oscillophone and read by the operator in charge.

Transfer Systems and the Multiple Board in Telephone Exchanges.—I.

BY ARTHUR V. ABBOTT, C.E.

THE switchboard in a small exchange consists of a single panel in which the subscribers' terminals are placed. As soon as this panel is filled the natural course of growth places a second frame beside the first, and when the second panel is exhausted a third is added. So long as three panels provide sufficient space for the jacks and drops, an operator seated before either can reach all subscribers, and if the traffic be sufficient to require the services of more than one operator, each can reach all lines. When, however, the exchange comprises more lines than can be placed in three panels, it is impractical on such a board for all operators to reach all jacks, and, therefore, impossible for each, unaided, to complete every connection that might be demanded. Two methods of solving this problem are in use: The transfer system and the multiple switchboard.

The transfer system is the earlier method, and it is still used for small offices. In addition to subscribers' lines, each operator is provided with a number of jacks and drops, from which circuits extend to every other position in the switchboard. When an operator is requested to connect a calling party with a subscriber located in a panel out of her reach, she inserts the connecting plug into a jack communicating with the panel in which the desired subscriber's jack is located, and rings upon this line in precisely the same manner as if she had plugged into the jack of the subscriber desired. The falling shutter of the drop associated with the jack notifies the operator before whom it is placed that a call is to be answered, exactly as if this drop was the original signal of the subscriber. The second operator inserts the answering plug of a pair of cords into the jack indicated, asks the subscriber for number and completes the connection in the ordinary manner. As by this plan a call is *transferred* from one operator to another, this system is known as the transfer system, and the lines which connect different positions in the switchboard with each are termed "trunk lines." There are many defects in such a system. As the services of two operators are required the cost of operating is increased. Either the subscriber must repeat his order to the second operator, or, if the first attempts to transmit the number, mistakes are inevitable.

The number of calls transferred will depend upon the size of the switchboard, and, assuming traffic to be equally distributed over all lines, it is easy to calculate this. Suppose N to be the number of sections in the switchboard, H the total number of messages, and that each operator can reach the section in front of her and over one section at each side. The number of calls arriving at each section is $\frac{H}{N}$, and $\frac{1}{N}$ of these messages must be completed at each panel of the whole board. Consider first the $\frac{H}{N}$ calls made at any section excepting an end one, then $\frac{H}{N} \times \frac{1}{N}$ or $\frac{H}{N^2}$ will be answered on each panel, and as each operator can reach three panels, each one can complete, unaided, $\frac{3H}{N^2}$ of the calls that originate in the panel in front of her. Discarding the two end panels whose operators can reach only two panels instead of three, there will be $N-2$ such sections, each of whose operators can complete $\frac{3H}{N^2}$ of the calls she receives, or $3(N-2)\frac{H}{N^2}$ messages completely unaided. At each of the end sections each operator can complete $\frac{2H}{N^2}$ messages; hence the total unaided completed connections will be $3(N-2)\frac{H}{N^2} + \frac{4H}{N^2} = \frac{H}{N^2}\,3(N-2)$, and the percentage of unaided completed messages $\frac{3N-2}{N^2}$. This formula shows that the number of unaided messages varies as the square of the number of panels.

Under the system described, all transferred messages are handled by two operators, and each one has to perform precisely as many and exactly the same movements as are used to connect two subscribers that are within her reach; therefore, the cost of the operating labor for all such messages is doubled, and in addition there are the interest, depreciation and maintenance charges on the trunk-line plant, in addition to the delay and inconvenience to which the subscriber is subjected, which cannot be measured in dollars. In spite of these defects the transfer system was for a long time the only method of operating, and under various modifications and guises it still survives and claims as warm advocates many whose telephonic education and skill are of the highest order.

In a way every large exchange may be said to be a transfer system, because whenever there is more than one office some messages must be handled over trunk lines, and except for the mere cost of the additional wire needed to join the panels, it makes no difference whether the sections are ten feet or ten miles apart. Essentially, therefore, all forms and devices for trunking may be classed as transfer systems, and, broadly speaking, toll and long-distance lines fall in this category. Technically, however, the term transfer system is usually understood to cover only methods of handling telephone traffic between the sections of a non-multiple switchboard located in the same office.

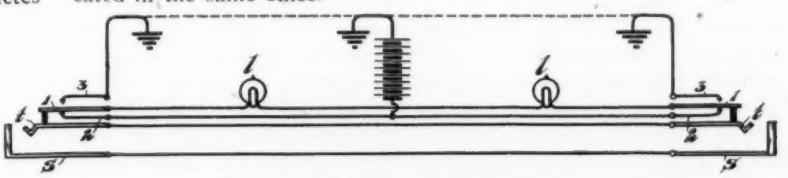


FIG. I.—SIMPLE TRANSFER CIRCUIT.

A simple and inexpensive transfer circuit for small exchanges, using incandescent lamps as signals, is shown in Fig. 1. Each panel is provided with enough jacks, so that sufficient lines may extend to every panel out of the operator's reach. Each consists of a sleeve S (Fig. 1) and a spring t; these form the talking circuit, and are connected to the trunk line wires. There are three other springs, 1, 2 and 3. Spring 2 nominally is in contact with spring 3, resting upon an insulating block which connects it to spring t. Upon the insertion of the plug, spring t is raised, spring 2 separated from spring 3 and forced into connection with spring 1. Inspection shows that springs 2 of each pair of jacks are connected with one pole of a battery, while springs 3 are connected to the other pole. Springs 1 are respectively connected to one of the poles of the incandescent lamps e and e; when both jacks are unplugged, both of the lamps e and e will be dark. If either operator inserts a plug into the jack in front of her, both of the incandescent lamps will light, and when both plugs are inserted both lamps will be dark. The operation is as follows: Suppose A operator receives a call for a subscriber located in the panel B, she inserts a plug into the jack A illuminating the lamp e and e. The B operator, seeing the illumination of the lamp, inserts an answering plug into the jack B. This extinguishes both lamps and informs the A operator that the B operator plugged into the jack. The B operator asks the subscriber for his order and completes the connection. As soon as the subscribers have finished conversation, and actuate their clearing-out signals, either the A or B operator removes the plug from the trunk jack. The incandescent lamps give a clearing-out signal to the other operator. As soon as the remaining plug is removed both lamps become dark, indicating that the trunk is free.

Such a transfer system is simple and efficient. The objections lie in the expensive and complicated jack and in the fact that each trunk line requires five wires. When few lines are needed and the distance between the panels short, the cost of the jack and of the trunk-line cable and the space required become unimportant. But when long trunking circuits are to be used, economy in wire plant is paramount, and has led to the invention of many ingenious circuits.

In the discussion of trunking it has become customary to denominate the operator who receives the subscriber's call the *A* operator, or originating operator, while the other who co-operates in completing the connection is termed the B, or incoming trunk, operator; either *A* operator must tell the *B* operator the number of the desired line or else the *B* operator must ask the subscriber to repeat. Modern methods adopt the first course. Two plans are in use. Both operators may bridge their talking sets across the trunk line and use it to give and receive the order. For the transfer systems employed in small and medium-sized offices this is sufficient, but in large offices the volume of business is so great as to overcrowd the trunk lines and render a separate circuit, called an order-wire, economical. The order-wire is a pair of conductors which extend from all the *A* operators to a head telephone placed upon the ear of the *B* operator. Each *A* operator is supplied with an order-wire key that by touch of the finger connects her talking set with the call wire, so each one can instantly speak to the *B* operator. The order-wire greatly simplifies the trunk circuit, for if the *A* operator can speak at once to the *B* operator, there is no need of any calling signal; hence the lamps, the extra springs in the trunk jacks and three of the wires of the trunk circuit may be omitted.

Consider a set of several trunk lines each one starting in jacks placed in front of a number of *A* operators, and ending in a plug on the cord shelf in front of a *B* operator. If any *A* operator receives an order for a line out of her reach, she touches the order-wire button, extending to the operator (*B* operator) before whom the desired line does appear. For an instant the *A* operator listens to see if any other *A* operator is speaking, and, finding the call wire clear, pronounces the number of the line desired. The *B* operator replies by speaking the number of the trunk line that the *A* operator is to use. Simultaneously the *A* operator inserts her connecting plug into the trunk line jack designated by the *B* operator, and the *B* operator inserts the same numbered trunk line plug into the jack of the called subscriber, the whole operation being completed in two or three seconds. This system is usually known as the reverse-call-circuit trunking system, and is now universally employed between the offices of all large exchanges. The same method may be used for clearing-out. When the subscribers display their disconnect signals, either operator may use the call wire to order the other one to disconnect. But this method has been found cumbersome and confusing, so present practice equips trunk lines with automatic disconnect signals so arranged that when the *A* operator removes the plug a signal is given the *B* operator to disconnect.

The theory of all transfer systems is that of conveying the *message* to the *called* subscriber's line; the *Multiple Board*, which forms the alternative solution of the problem, reverses this and carries the *called* subscriber's line to the *message*. Consider the diagram of Fig. 2, which illustrates a switchboard of say 400 lines divided into

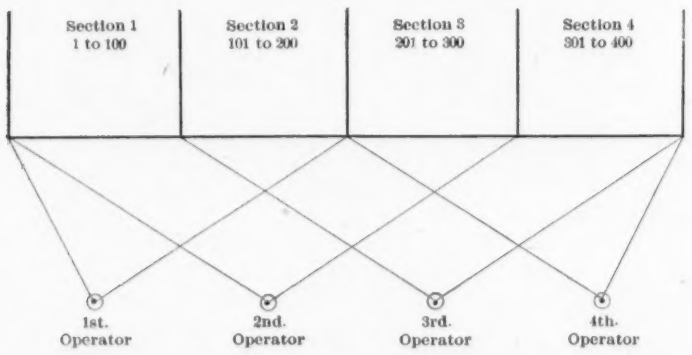


FIG. 2.—DIAGRAM ILLUSTRATING MULTIPLE SWITCHBOARD.

four panels of 100 lines each, served by four operators. The diagram shows that if the subscribers' lines terminate as shown the various operators can complete connections as follows:

Operator.			
1	to all lines between	1	and 200
2	to all lines between	1	and 300
3	to all lines between	101	and 400
4	to all lines between	201	and 400

The operators are unable to reach lines as follows:

Operator.			
1	cannot reach lines	201	to 400
2	cannot reach lines	301	to 400
3	cannot reach lines	1	to 100
4	cannot reach lines	1	to 200

Now, suppose that in the various panels a lot of surplus jacks be placed, and that the various subscribers' lines be extended and connected to several jacks in such a manner that there is a jack attached to every line within the reach of each operator. Manifestly each operator can complete a connection with every subscriber, and no transfer is necessary. This is the principle of the *multiple* board, which takes its name from the fact that every line has its jacks *multiplied* a sufficient number of times to give every operator access to it. It is unnecessary to multiply the subscribers' calling signal, for when he calls the office the attention of one operator amply suffices. Hence in a multiple switchboard the subscribers' line consists of a calling signal and jack associated therewith (the answering jack) placed before the operator commissioned to attend to the particular subscriber, and a string of other jacks varying in number depending on the size of the switchboard, so arranged as to give all other operators access to the line.

Fig. 3 gives a typical multiple switchboard circuit. Three operators' positions are represented, Nos. 1, 2 and 3, and three lines,

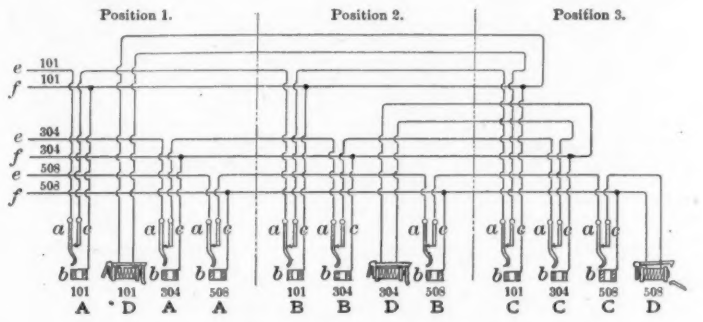


FIG. 3.—TYPICAL SERIES-MULTIPLE SWITCHBOARD CIRCUIT.

Nos. 101, 304 and 508. The drawing shows that each jack consists of two springs, *a* and *c*, normally in contact, and a ring *b*. Each subscriber's circuits may be traced as follows: Taking line 101 from the point *e* where each line enters the board to spring *a* of jack *A* in position 1 to spring *c*, thence through the springs of each of the other jacks in positions 2 and 3, thence to drop *D*, and thence out by the wire *f*. To the *f* side of the line, a branch wire is carried from the jack rings in each section, so that the rings are all in parallel, while the *e* wire of the line runs through the jack contacts in series. The drop is placed last on the line, hence when a plug is introduced it lifts the spring *a* away from spring *c*, and so opens the circuit and cuts off all apparatus connected to *c* spring, relieving the line of all superfluous parts during conversation. The signal and jack associated therewith at the end of the line (including the distributing board outfit) are usually called the subscriber's terminal. For each subscriber there must be one complete terminal. The other jacks are termed the *multiple*, and will vary in number, depending on the size of the board.

Recent Electrochemical Developments.

ELECTRIC FURNACE CONSTRUCTION.

Most electric furnaces now in practical use are designed for intermittent operation—which, for refining and finishing operations, exactly fits the case. On the other hand, where a large output is desired of a relatively crude product, operation is almost universally continuous in metallurgy, or there is at least a strong desire in such cases to render the process continuous. In electric furnace practice there is, for instance, the oven with calcium carbide. The more the electric furnace is coming into use for purposes of this nature the more important is the continuity of the furnace operation. In a recent patent, granted to C. L. Saunders, this is accomplished by means of a continuously revolving circular or annular hearth. The material to be treated is continually charged into the same, while the electrical connections to the furnace are made in such a way that a given zone or area of the hearth is brought into electrical circuit. While passing through this zone the material undergoes the desired change, whereupon it is discharged. The mechanical details of the electrode connections are described.

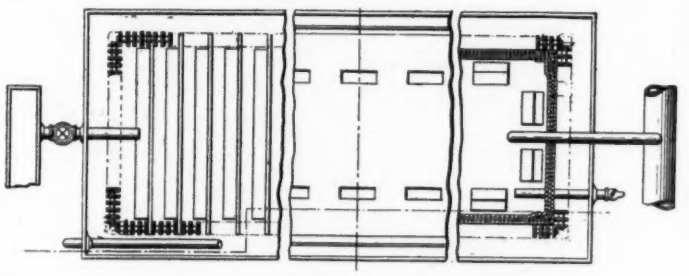
In best metallurgical practice the treatment of an ore into a finished product is divided into a series of successive steps, producing different effects; it is only in single steps—and generally in the refining or finishing steps—that electric heat is economical under

present conditions. This well recognized principle is again indicated in a recent patent of G. H. Benjamin. His furnace consists essentially of four distinct chambers: the calcining chamber with inclined hearth, from which the material passes into the reducing chamber, also with an inclined hearth. Then follows, thirdly, a vertical chamber, below which is, fourth, a basin, which again is in connection with an oxidizing chamber. All these chambers are arranged at progressively lower levels. Only the third, vertical chamber, is electrically heated, the material passing through electric arcs. Regenerative heating is applied.

ELECTROLYTIC PROCESSES.

In processes in which the solution of a salt is electrolyzed, the chief problem is to keep the anodic and cathodic products of electrolysis separate from each other. John F. Kelly tries to accomplish this by means of a three-compartment cell, the salt to be electrolyzed being fed into the middle compartment so that the anolyte and catholyte come into contact with the non-decomposed salt only. If applied to sodium sulphate the catholyte is sodium hydroxide and the anolyte sulphuric acid.

In the electrolysis of common salt, the analogous difficulty is to prevent the sodium hydrate, which is formed at the anode, from



LARCHAR CELL.

passing into the anolyte which is saturated with chlorine. A. B. Larchar, in a recent patent, uses for this purpose the cell construction shown in the illustration.

The main feature is the construction of the cathode in form of a grating extending all the way around the cell along the four side walls. The grating consists of steel bars or slats, and upon it is stretched the diaphragm. In the middle of the cell are the anodes of graphite. The electrolyte passing through the diaphragm is divided into a great number of films (between the slats of the grating); these films are in intimate contact with the cathode surface. The inventor adjusts the surface levels of the electrolyte so as to maintain the inside level (of the anolyte) slightly above the outside level, whereby backward diffusion of the caustic through the diaphragm is stated to be prevented.

A. G. Betts' electrolytic treatment of electrolytic slimes (especially those from his own lead refining process) has already been mentioned in these columns. The process is covered by a patent granted on June 20.

L. Dion has patented an apparatus for the electrolytic treatment of mine waters, etc., for the recovery of metals. The main features are mechanical details of construction of the cell, the electrodes and the filter.

BATTERY INVENTION.

Edison's great mechanical skill has undoubtedly solved the mechanical problems of general construction of the alkaline storage battery. Nevertheless, there is still room for improvements in the chemistry of the cell, especially in the preparation of the active materials. Four recent patents refer to such problems.

A. Meister and A. Junker prepare an active nickel electrode for use in the nickel-iron alkaline cell in the following way. Strips of metallic sheet nickel and strips of sheet pulp or asbestos are placed alternately upon each other and are soldered together at top and bottom. This plate is then formed electrolytically as anode in a weak solution of caustic potash containing a small quantity of phenylate with a sheet-nickel plate as cathode.

H. C. Hubbell prepares a nickel electrode, composed of hair-like fibres of nickel intertwined and embedded in a mass of nickel oxide, so as to form a plastic mat or cake. The same inventor makes a silver electrode with a perforated foundation plate of nickel-plated iron, upon which is deposited on both sides a mass of finely divided silver oxide, extending through the perforations, and thus held firmly to the foundation plate. Around this is folded a layer of asbestos paper, and around this a layer of fine nickel wire-gauze. In a third patent of the same inventor a zinc electrode (for use in an alkaline accumulator of the Waddell-Cutz type) is described. He uses a steel skeleton of the following construction, affording a large area for the zinc deposit. It consists of a series of transverse troughs formed of steel strips and having their ends pinched together. Vertical U-shaped channel-plates are firmly connected to the ends of the troughs, and are crimped at their ends to holds the troughs in place.

Four recent patents of H. C. Porter refer to details of construction of storage batteries of the pasted (Brush-Faure) type, three patents relating to three different mechanical constructions of the grid and the fourth patent to the construction of a plate separator. Another construction of a battery grid is described in a recent patent of M. Heisser.

I. Kitsee endeavors to restore the usefulness of overcharged active material in lead accumulators by bringing the active material into contact with a material adapted to in part reduce said active material to a lower oxide and in part change the same to a salt "adapted to act as binder for the particles of said lower oxide." For this purpose chloride of sodium may be used, applied to the electrode moist with the sulphuric acid; or sulphurous gas may be made to act on the moist plate.

A patent of T. S. Witherbee refers to mechanical details of construction of a storage battery jar for automobiles; a patent of P. J. Kamperdyk to mechanical details of construction of a double-fluid primary cell, especially to the construction of the porous cup.

ELECTROMAGNETIC AND ELECTROSTATIC SEPARATION.

Magnetic separation or concentration of ores is a time-honored art and in many cases lean ores have thereby been rendered available for economical treatment. New inventions in this field relate mostly to modifications in the mechanical construction of the separators or to processes for working special materials. H. H. Campbell employs, according to a recent patent, an inclined table with a series of electromagnets arranged in a diagonal row, adjacent to the table. These electromagnets are subjected to reciprocating motion lengthwise of the table. At the end of their forward stroke they are demagnetized and are again remagnetized immediately before they reach the limit of their return stroke. The magnetic particles are thus carried downward, step by step, in a diagonal direction, while the non-magnetic particles simply descend the table unaffected.

E. Kelly and A. Munson have recently patented a process of magnetic separation of ores whereby the usual drying-out step is eliminated as far as those bodies of ore are concerned wherein the percentage of hoisture is inappreciable. They first separate ore of a given size from ore or fines of smaller size, dry out the ore of the smaller size and subject the ore of the larger size to the action of a magnetic separator so as to separate out, as heads, all ore with a given percentage of magnetite, from that, as tails, with a lower percentage. They then reduce these tails and subject them, reduced, and the fines to further magnetic separation.

E. Hedburg has recently patented the following process of treating certain complex ores. The ores are roasted and subjected to the action of a hydrocarbon gas, the effect of which is that the copper, nickel and iron ores become magnetized, while the zinc ores remain non-magnetic. The ores are separated magnetically.

Two recent patents refer to magnetic separation in connection with the recovery of gold. E. S. Bennett removes magnetic iron from placer-sand while the same is being subjected to the action of the gold-saving apparatus, such as an amalgamating tank or a gravitating tank. The primary object is to save gold, including the infinitely fine particles which are found adhering to the exterior of the grains of iron sand. For this purpose he subjects the iron sand to a scouring action of jets under high pressure, which separates from the iron sand the microscopic particles of gold. The iron sand particles denuded of the gold are immediately removed magnetically from the tank, so as not to interfere with the subsequent recovery of these free gold particles.

L. T. Weiss patents a peculiar process for separating particles of non-magnetic metals, such as gold, for example, from sand. Each particle of the metals is first plated in a mass with iron by electrolysis, which is followed by magnetic separation. An electroplating apparatus for this purpose is described.

While electromagnetic separation is old, electrostatic separation has been introduced into practice only in recent years, mainly through the work of Blake and Morscher. A combination of both methods has recently been patented by H. M. Sutton, W. L. Steele and E. G. Steele. In their apparatus, the action of a magnetic roller is combined with a statically charged device for conveying the ore to the roller and charging the ore.

Removal of the Diverting Dam of the Ontario Power Company, Niagara Falls.

The diverting dam in the Niagara River, which has shielded the intake works of the Ontario Power Co. during their construction, is now being rapidly and successfully removed. This dam was built in 1903, extending out from shore above the upper line of rapids and laying dry an area of about 18 acres, including the water courses about the Dufferin Islands. In June, water to operate the first 10,000-hp unit was admitted to the forebays by a sluiceway cut through the dam.

This diverting dam is about 900 feet long, 250 feet of it extending out from shore at nearly a right angle, and the remainder running at an angle down the stream, thus turning the water out toward the middle of the river. It is built of bottom cribs 31 feet long, 16 feet wide and 11 feet deep, which were floated into place, and sunk by loading with stone. No puddle was used, but the dam was made tight by bags of cement placed on the rock bed of the river

REMOVING DIVERTING DAM IN NIAGARA RIVER.

against the upstream face of the cribs, and by double-lapped tongue and groove sheet piling driven into these bags. A diver, protected from the swift current by a timber shield, placed the bags of cement and fitted the piling to conform to the irregularities of the river bed. This construction has proven very successful, as very little water has leaked through the dam.

The removal of the dam is accomplished by unloading sections or cribs one at a time, and by swinging as on a hinge in toward the shore, into the quiet water behind the remaining portion of the dam. The stone fill is removed by common labor, no diver being required. An interesting, and in fact surprising, feature of the operation of removal, is that after a crib is unloaded, in spite of the terrific force of the current, it seems almost as stable as before, although held in place only by the small quantity of cement above mentioned. The combined power of a hoisting engine on shore and a derrick on the dam is required to loosen the cribs from the bed of the river, after which they swing easily around toward the shore, as shown in accompanying photograph.

New Telephone Patents.

SEMI-AUTOMATIC SYSTEM.

A sort of semi-automatic system upon novel principles has been patented by Eugene Darnell, of Carrollton, Mo. With this system each line is connected to a switching device which combines both electrical and mechanical features. The former control the usual listening and signaling circuits, while the latter control the interconnecting devices.

From each switching device there hangs a tube carrying at the free end contact ears which form the final terminals of each line. Beneath these tubes there extends a wide belt upon which is mounted a series of transverse members which are made up of two contact plates secured to the sides of an insulating strip.

As soon as a signal is answered and the operator finds out the desired line, by means of the mechanical action she throws the contact lugs of both lines into engagement with the contact plates of a strip upon the belt, and thus connects the two lines and locks them. In order to prepare for the next call the belt is automatically stepped along so that the next contact bar comes into place, the tubes of the connected line following along with the bar to which it is connected.

As soon as a connection is complete, the hanging up of the receiver causes the contact lugs to release the bar, and then they return to the disengaged position automatically.

The idea is to group a set number, say 100 lines, on each section of the switchboard, a transfer trunking system between sections being contemplated.

NEW INSTRUMENTS.

A new transmitter is shown in Fig. 1. This is the work of W. E. Harkness, of Elyria, Ohio, his patent being assigned to the Dean

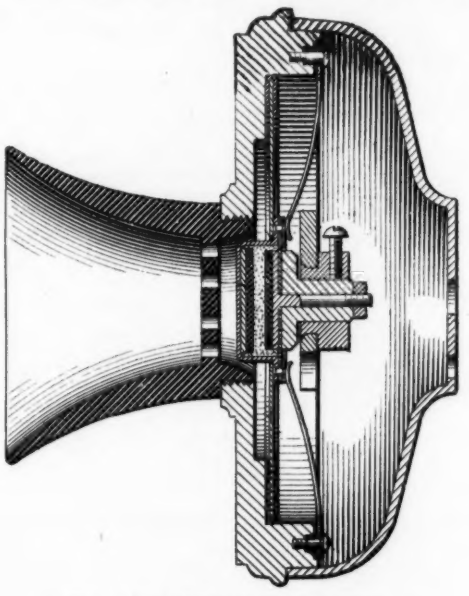


FIG. 1.—HARKNESS TRANSMITTER.

Electric Company. The diaphragm is perforated to receive the pressed electrode chamber, the flange of this latter resting against the diaphragm. The front electrode is secured within the chamber, while the rear electrode is held by an auxiliary mica diaphragm. The chamber is secured to the diaphragm by the pressure of the damping springs alone. Thus a most flexible connection is obtained which is so arranged as not to interfere with the motions of the diaphragm.

T. E. Brecht, of Washington, D. C., has patented a most peculiarly designed receiver. No permanent magnet is used, the inventor relying upon a battery for polarity effect. The core supports the diaphragm by a single lug passing through the latter's center. About the core is a wooden sleeve, and over this a sheet metal casing. A winding of several small coils connected in parallel completes the magnetic system. This whole is then enclosed in a switch casing.

BUSY TEST.

With two-wire systems, if the busy test shunts any appreciable current from the connected lines, an objectionable sound will be produced in the corresponding receivers. This disadvantage has been overcome sometimes by including in the test circuit a high-impedance relay, which did not affect the connected circuits. This relay controlled local circuits of proper power. Mr. H. G. Webster, of Chicago, has worked upon another principle. He has obtained patents for two systems in which the test tip is maintained so near the potential of the test ring of busy lines that the disturbance due to its contact is negligible. These patents have been assigned to the Stromberg-Carlson Company.

SERVICE METER.

Messrs. C. E. Scribner and F. R. McBerty, of Chicago, have brought out another service meter or counting device adapted for the subscribers' premises. In this case the count is to be registered by the operator, but not until the conversation is completed and the receivers returned to their hooks. A rising switch hook causes a controlling relay to operate to connect the meter to the line, but

this relay is immediately released, as it is shunted out by the hook as this reaches the end of its upward stroke. On the down stroke the shunting action is missing and the relay comes up and locks itself as its contacts are thus connected with its winding. The meter is thus locked-connected to the line at both stations, but it does not operate because it is connected between the ground and the grounded limb of the line.

To make a count the operator must push her key. This action sends a sufficient impulse of current out toward the calling line to effect a count, and then the key momentarily severs the connection between the locked relays and the battery. These relays are restored to place and when the operator releases her key all connections are normal. The Western Electric Company has obtained this patent by assignment.

EXCHANGE SYSTEM.

A two-wire common battery system is shown in Fig. 2. It will be seen that the cut-off relay is differentially connected, and thus does

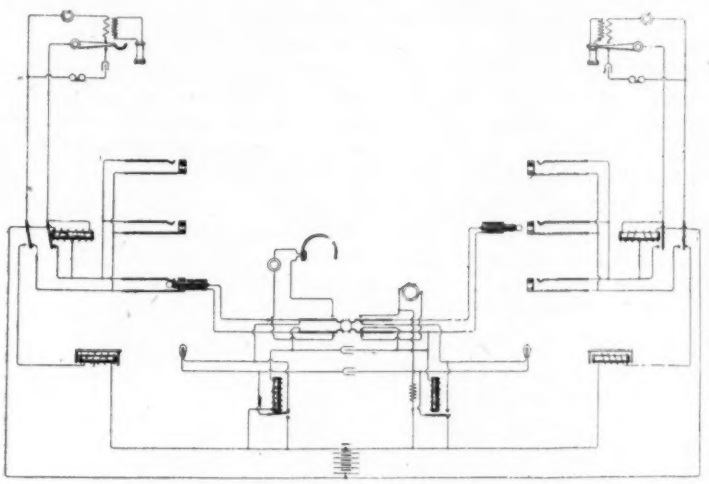


FIG. 2.—LAND EXCHANGE SYSTEM.

not respond to the initial current which sets the line signal. When a plug is connected to the line the balance is destroyed and the cut-off relay is pulled up. The supervisory relay serves as a retardation coil through which current is fed to one side of the line, the other side being connected directly to the battery. It is easy to trace how the supervisory relay cuts its lamp into and out of circuit, the current finding a path back to the battery through the jack sleeves. This system, which was invented by E. Land, of Grand Rapids, Mich., has been assigned to the Stromberg-Carlson Company.

INTERCOMMUNICATING-SYSTEM SWITCH.

A self-restoring switch for intercommunicating systems has been patented by Messrs. R. Weman and H. M. Bascom, both of New York City. With this switch, when ringing is done by depressing the switch handle, the contact wipers which normally clear the contacts are depressed and locked against the contacts. When the hook switch is depressed these are released and fly back under spring pressure to clear the circuits.

RECEIVER HOLDERS.

Two patents have recently been granted for receiver holders, one to F. F. Howe, of Marietta, Ohio, and the second to V. Reblum, of Schaghticoke, N. Y. Both supports have a horizontal arm link to the switch hook. Mr. Reblum, in addition, includes a receiver cap adapted to form a closed sound chamber about the ear.

LETTER TO THE EDITORS.

The Electrolytic Detector for Electric Waves.

To the Editors of Electrical World and Engineer:

SIRS:—The question of priority in the case of the electrolytic detector for electrical waves has recently been the subject of considerable discussion, both in the electrical journals and in the courts. I notice in the issue of the ELECTRICAL WORLD AND ENGINEER for May 6 a letter from Prof. Blondel on this subject, in which attention is called to the work of Capt. Ferrié in the year 1900. This of course antedates the work of Fessenden, De Forest and Schlömilch, at least so far as publication is concerned. I wish, however, to call attention to a still earlier paper on the electrolytic receiver, namely, that of Prof. Pupin, which was read before the American Physical Society on October 28, 1899, and published in abstract in the second number of the Physical Society Bulletin (Vol. I, No. 2, page 21). It so happened that I was lecturing at that time on the subject of "Electrical Waves," and being much impressed with the ingenuity of Prof. Pupin's device I showed to my class several experiments illustrating its employment in the detection of electrical waves within a few weeks of the meeting at which Prof. Pupin's paper was presented. In my lectures on electrical waves since that time I have always shown the operation of the electrolytic detector, and have, of course, given credit for its invention to Prof. Pupin.

I might add that the abstract in the Physical Society Bulletin, although sufficient to establish priority, does not by any means do justice to the clearness and the completeness of the discussion contained in Prof. Pupin's original paper.

CORNELL UNIVERSITY, ITHACA, N. Y. ERNEST MERRITT.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

Tendencies in Electrical Engineering.—JANET.—A paper read before the French Physical Society. The author first shows the tendency of increasing the capacity of generators. The largest dynamo at the Exposition of 1889 gave 250-kw, in 1900 it was 3,000-kw; now we have units of 5,000 to 8,000 kw. The increase of the voltage has led to the modern generator with large diameter, running at a low speed. Some notes are given on the turbo-alternators, which now will become the great machine of the future. If one compares the dimensions of the revolving fields of two three-phase, 350-kw., 2,000-volt alternators, one driven by a steam turbine at 3,000 r.p.m., the other by a steam engine at 142 revs., it will be found that the dimensions parallel to the axle are increased for the turbo-alternator from 65 to 80 centimetres, while the diameter is reduced from 310 to 50 centimetres; the centrifugal force is, therefore, much greater in the turbo-alternator. Increase of power of a turbo-alternator necessarily leads to an increase of the dimensions parallel to the axle. Two 5,000-volt alternators, running at 1,500 revs., one with a capacity of 480, the other of 2,000-kw., have approximately the same diameter (95 centimeters), but different lengths, equal to 460 and 1,200 centimeters. He then discusses the following three problems in connection with alternators: Operation in parallel, compounding, suppression of higher harmonics. In discussing prime movers he briefly mentions water turbines, discusses at some length the advantages of steam turbines and refers to gas engines. With respect to the utilization of the waste gases of blast furnaces, he says that "when all of this energy will be utilized—and this is possible only in form of electrical energy—then the iron production will be the accessory and the electrical energy production the main thing in blast furnace countries." Some notes are given with respect to power transmission, electric traction and electric lighting.—*Revue. Gen. des Sciences,* June 30.

Induction Motors.—WORKMAN.—The author describes precautions which must be taken in making a locked saturation test of induction motors.—*Elec. Jour.,* July, 1905.

Mercury Vapor Converter.—THOMAS.—An article illustrated by diagrams discussing the general theory and construction of this apparatus.—*Elec. Jour.,* July.

LIGHTS AND LIGHTING.

Incandescent Lamp.—MARSHALL.—An illustrated Franklin Inst. paper on the development of the Edison incandescent electric lamp from 1881 to 1905. The Edison lamp of today embodies every feature of the lamp of 1881. The progress has been due to changes in details and in improvements in processes of manufacture. The author gives a large amount of information concerning this de-

velopment. Perhaps the element which has contributed as much to the improvement of the lamp as any other is inspection. The following table shows the change in the life of the lamp, coincident with changes in its elements and the method of its manufacture:

Type of filament.	Year.	Watts. per c.p.	Actual life in hours.	Life to 80% of initial c.p. in hours.
Plain bamboo	1881	5.8	3,000	...
Plain bamboo	1881	4.56	900	...
Asphalted bamboo	1888	3.1	1,000	200
Treated bamboo	1893	3.1	1,200	260
Treated squirt	1896	3.1	700	370
Treated squirt	1900	3.1	750	425
Treated squirt	1904	3.1	800	475

The later improvements corresponding to different periods were obtained, not by elemental changes in the lamp, but by a very gradual improvement in the processes. When the importance of maintenance of candle-power began to be appreciated, it was necessary to decide at what percentage of its initial c.p. a lamp is no longer useful and better be taken out and destroyed rather than allowed to burn longer. This point has, by common consent, come to be fixed at 80 per cent of the initial c.p. In the above table the life to 80 per cent is not given for the earlier lamps, because at that time the importance of that factor had not been recognized. As the life to 80 per cent first began to increase it was accompanied by a very decided decrease in the actual life. The previous long actual life had been due to the rapid diminution of c.p. and the consequent low temperature at which the filament burned.

The 1896 lamp, although having a very much shorter actual life than the 1893 lamp, was really a much better lamp because of the longer life to 80 per cent c.p. The following table shows the life we can expect from 16-c.p. lamps of different efficiencies. The first line gives the watts, the second the life in hours to 80 per cent of initial cp:

Watts	32	40	48	56	64	72	80
Hours	28	132	412	1000	2005	3570	6125

These lamps are all of the same quality and, if burned at the same temperature, would not vary greatly in life. The very great difference in life is due to the difference in temperature. The 80-watt lamp has 4.25 times the surface of the 32-watt lamp, and the light per unit of surface, and consequently the temperature, is very much less. At the usual prices of lamps and electrical energy, the 32-watt lamp, though taking little energy, is not economical, because of the very short life and consequent frequent renewals. On the other hand, the 80-watt lamp, though having a very long life, is not economical, because of the large amount of energy used. In general, the higher the cost of electrical energy and the lower cost of the lamp the lower should be the specific power consumption of the lamp selected.—*Jour. Franklin Inst.,* July.

Street Lighting With Nernst Lamps.—HOADLEY.—A paper presented to the (Brit.) Municipal Elec. Asso., discussing the problem of "side-street lighting" (where arc lighting is out of place) from the point of view of the British central station engineer. First, there was competition between the flat-flame gas burner and the carbon filament incandescent lamp, and the latter had, if anything, the better of it. Then the incandescent gas mantle got the best of it. Then came the Nernst lamp and, with respect to it, extensive tests are described by the author. His results show that a 0.5-ampere Nernst lamp at 230 volts gives a degree of illumination superior to that given by an incandescent gas mantle burning 4 cubic feet of gas per hour, both when measured by an illumination photometer in the streets, and, what is far more important, when judged by the eye of the general public. Taking the average inclusive cost of one of these gas lamps at $17.50 per year, he finds that the total cost to the ratepayers of the municipal undertaking of electric lighting by Nernst lamps will be less if electrical energy is supplied at 2.6 cents per kw-hour. (The tests were made with the Nernst lamp of the Allgem. Elek. Ges., of Berlin, which owns the patents for Great Britain.) The author thinks that the Nernst lamp, although still far from perfect, has been "the savior of the side-street lighting business for the electrical world." He suggests some improvements for the German make of Nernst lamp. The ideal lamp for the lighting of the less important streets will, the author thinks, be found eventually in a small flame arc lamp taking about 100 watts, and having a magazine feed so that it will burn for some 60 or more hours without attention. The paper was extensively discussed.—Lond. *Elec.,* June 30.

New Incandescent Lamp.—In a paper by Janet on tendencies in electrical engineering, a new lamp, devised by Canello, is mentioned which has a filament formed of oxides of alkaline earths, covered with a thin layer of metallic osmium. It is, therefore, a combination of the principles of the Nernst lamp and the osmium lamp.—*Revue Gen. des Sciences,* June 30.

POWER.

Electric Winding Machines.—HABETS.—The first part of an English translation of his French paper, presented before the (Brit.) Institution of Mechanical Engineers in Liege. The paper gives a very full discussion of the subject. It is profusely illustrated by diagrams and is partly of a mathematical character. The author begins with a dynamic investigation of haulage and discusses the statical moments, the resistances, the moments of inertia of the suspended loads, the moment of inertia of the rope roll, the moment of inertia of the head-gears, the moment of inertia of the winding gears and of the motors, the moments of the accelerating forces, and the power and expenditure of energy. The author then discusses the electric motors used for haulage—either three-phase induction motors or direct-current motors—especially with respect to their starting qualities. The only method which has been used for starting three-phase motors for driving haulage machinery, consists in inserting variable resistances in series with the three circuits of the secondary. The Allgem. Elek. Ges. has designed a rheostat with liquid resistance, consisting of two vessels, the one above the other. The liquid is kept in motion by a small centrifugal pump which takes the liquid from the lower vessel and forces it back into the upper vessel, in which three metallic plates—each for one secondary circuit—are suspended, as shown in Fig. 1. The upper vessel has an overflow, and the plates are only immersed to a depth corresponding to the required resistance. By manipulating the starting lever, which works the reversing switch and closes the inductor circuit, a stop valve V_2 will be closed; the level of the liquid in the upper vessel will, therefore, rise, and the plates will be more and more immersed. The rate at which the water rises can be regulated by a cock on the inlet pipe. The maximum speed of the machine is reached when the liquid has risen to a second overflow, which is always open. When the lever of the reversing switch has been pushed home to the right or left, according to the direction in which the machine is to turn, it may be moved back through a certain angle without breaking the circuit. In doing this, the stop-valve is gradually opened, so that the water can run out again, and the speed will be reduced as desired. The circuit will not be broken until the lever is turned back into its vertical position; as the level of the liquid is falling steadily, the current as well as the speed of the motor will be gradually reduced; the interruption, therefore, will not be sudden. The immersion of the plates may be further limited by an overflow, V_1, so as to reduce the speed when persons are carried up and down. When the pit or the ropes are to be examined, the speed may be still further reduced by regulating V_1. The intermittent working and the increased energy at starting cause sudden and irregular demands on the generators at the power station which must, therefore, be designed liberally and supplied with large fly-wheels. The direct driving of winding machinery by induction motors requires generators capable of standing a considerable overload, and the installation of very powerful sets at the power station. This means an increased expenditure for extra boilers, steam engines and alternators; but, on the other hand, the use of three-phase machines is much simpler and much less expensive than transforming alternating current into direct current. The author then discusses the use of direct-current motors and gives the principal formulas and discusses the following methods of starting: 1. Starting with a rheostat (the same loss of energy as with three-phase motors. 2. Series-parallel control (as on tramcars). 3. Batteries in section (economical, but complicated). 4. Special generator; the haulage motor is separately excited by a constant current, and the difference of potential is varied, and therefore, also

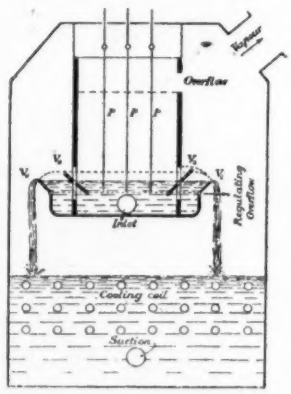


FIG. 1.—LIQUID RHEOSTAT.

the speed, by regulating the e.m.f. of the generator which supplies the motor by means of a field rheostat; the generator must be able to stand all the variation of the load, and the engine driving the generator will be running on no-load during the stoppages. The use of a special generator is not practical unless the haulage machinery is close to the supply station. Ilgner's system is then mentioned. 5. Auxiliary starting dynamo (its armature in series with the armature of the haulage motor across the mains of a constant-pressure circuit; both fields are connected direct to the mains). 6. Starting boosters. Examples of practical applications of these systems are mentioned. The paper is to be continued.—Lond. *Eng'ing*, June 30.

Austrian Water Power Plant.—STEENS.—An illustrated description of the central station at Zwömalgreien. The hydraulic power is furnished by the Eggenthalerbach, a creek having its source at the foot of the Latemar group in the Dolomite mountain chain. The central power-house is located at the entrance of the Eggenthal, near Kardaun. The equipment consists of three 500-hp turbines direct connected to three-phase, 60-cycle Oerlikon generators, which furnish current at a tension of 3,600 volts. This current is transmitted to several sub-stations in the vicinity where it is stepped down to 150 volts for lighting purposes. In only one of the several sub-stations does the primary enter through an overhead line. The transmission line runs underground to cylindrical turrets in which are placed the switches and transformers. The secondary lines are, for the most part, overhead. Arc and 32-cp incandescent lamps are used for street lighting.—*Amer. Elec.*, July.

Transmission.—VAUGHAN.—Some illustrated notes on the transmission of 20,000 hp from the Puyallup River to Seattle and Tacoma, Wash., at a distance of 50 and 30 miles, respectively. The transmission voltage is 55,000. Some details are given of the construction of the transmission line.—*Elec. Jour.*, July.

TRACTION.

Convention.—A full account of the fourth annual convention of the (Brit.) Municipal Tramways' Association. The papers presented will be abstracted later in the Digest.—Lond. *Elec.*, July 7.

Motor Connections.—GOUGH.—An article giving diagrams and discussing possible mistakes in motor connections and their effects. —*St. Ry. Jour.*, July 8.

Electric Buckboard.—BROCKSMITH.—A continuation of the article begun last month on the design of an electric buckboard. Complete information and drawings are given in the present article for the construction of the motor.—*Amer. Elec.*, July.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Presidential Address.—NEWINGTON.—His presidential address to the (Brit.) Municipal Elec. Asso. The first part of the address deals largely with financial problems, the repayment of loans, the methods of dealing with the profits of municipal electric stations, depreciation of plant, and reserve fund. Many more British towns are now making a profit, and in many instances large profits, as compared with a few years ago. In 1905, the number of British municipal central stations, not including tramways, making a profit, is 115, the surplus being about $2,180,000. Those showing a loss are 67 in number, the amount being $347,400. Of these 67 towns, 42 have completed only their third year of working. The corresponding figures for 1902 were 46 towns with a surplus of about $445,000, and 53 towns with a loss of $432,500. Gas experts are said to have improved the incandescent lamps to such a degree that it is now very suitable for street lighting where a large amount of light is not necessary and where, therefore, arc lamps would be too powerful. "Just at present there seems not to be any form of electric lamp that can quite compete with the incandescent gas mantle for this purpose," although some new forms of electric lamps are in a more or less promising experimental stage. Small householders should be encouraged to install electric light. For small houses where exposed wires would not be objectionable, a system in which fireproofed cables are carried on suitable insulators, fixed to the walls or ceilings, should be perfectly good. With electric motors, if it can be arranged that they are switched off during the two or three hours of maximum load for lighting in the four winter months, extra machinery will not be required, and so a very low rate can be charged. This system is just now being adopted in Edinburgh, and is also in force in a few other cities. He suggests that the members of the association should collect data, showing how far the motors connected to their system are used during the hours of maximum lighting load in the winter months.—Lond. *Elec.*, June 30.

Load Factor.—SINCLAIR.—A paper read before the (Brit.) Municipal Electric Assoc. on the load factor and its effect upon an electricity station. The author gives a series of diagrams to illustrate graphically the effect attained by incorporating various classes of supply mentioned with the ordinary lighting. The diagrams are intended to show what might be done in common practice in a town of 100,000 to 150,000 inhabitants and a station of 1,500 to 2,000-kw. He concludes that it is essential to the cheap generation of electricity to increase the load factor of a station by every possible means. He recommends the increasing of the ordinary lighting load by systematic canvassing. Public lighting should be extensively used. Great hopes may be held for the future of stations by dispensing power on a large scale to small users at cheap rates. He recommends the hiring out of motors. A traction load is a valuable asset. The author expressed the belief that a uniform price per kw-hour cannot be fixed for electricity, but the price must depends on the nature of the supply, i. e., quantity and load factor. The maximum demand system meets the requirements of the case, but it is too complicated. "If a system simple in itself could be arrived at whereby a customer's load factor could be readily and easily ascertained, his charge per unit could then be regulated by a discount on its rated price. By some such means, the ordinary customer, usually a man of business, would be appealed to because he would readily accept the situation if he is aware that his account is subject to a discount on the quantity (as gauged by his load factor) of energy he uses, whereas when confronted with the complex explanations of the maximum demand, he is amazed—always confused—and if his bill is high, never satisfied." The paper was discussed at some length, various speakers taking issue with the figures given in the author's diagrams. In an editorial note on this subject the following definitions of the load factor and of the diversity factor are given: "Load factor is the average load on the station throughout the year expressed as a percentage of the maximum load." The maximum load on the station is naturally less than the sum total of the maximum loads of each consumer, as these do not occur simultaneously, and "the diversity factor shows the relation between these two figures; it is the sum of the consumers' maximum loads divided by the actual maximum load on the station." It is claimed that in Sinclair's diagrams the diversity factor has not been taken into account. Attention is called to the ambiguity in estimating the load factor of a tramway system. In taking the maximum load for the calculation of the load factor, a difference of 100 per cent may well occur if the momentary maximum be taken instead of the highest load which occurs without taking account of the narrow peaks, which last only a few minutes. To be quite accurate, therefore, in comparing traction with lighting load factors, account should be taken of the relation between the widths of the peaks and the period for which the overload capacity of the machines is rated.—Lond. *Elec.*, June 30.

British Central Station Statistics.—The first part of the annual table giving a list of electricity supply works of the United Kingdom. The present part gives data on 190 stations (alphabetically arranged; this installment beginning with Aberdeen and stopping with Liverpool). Statistical data are given in 27 separate columns on the development and equipment, cost, etc.—Supplement to Lond. *Elec. Rev.*, June 23.

Compound Generators in Parallel with Storage Battery.—E. K. SCOTT.—An illustrated article on the equipment of a lighting station in Sydney, Australia. The plant contains five steam-driven, 220-volt generators, the armatures being wound on the Eickemeyer principle. They are arranged in such a manner that by re-connecting the armatures double the pressure can be obtained. There are 115 storage cells of 1,000 ampere-hour capacity, to help the plant at its heaviest load; they are recharged during hours of light load in the morning, the excess of voltage being supplied by a motor-generator set. The interesting feature is that although the machines are compound wound—or rather overcompounded 5 per cent—they are run in parallel with the storage battery; and this method has been most successful "for many years." "The regulation of the station is the most perfect the writer has ever seen, and the manager claims that it does not vary more than 1 per cent in a year." Fig. 2 shows the arrangement of the connections. One of the main switches for each

machine is of the I. T. E. circuit-breaker type, fitted with a special differentially wound coil by means of which it is tripped in case of a reverse current from the cells or from any other machine. In order to ensure that each dynamo shall take its fair share of the load, it is important that the resistances of the series coils shall be relatively proportioned for their respective outputs, and as this resistance is very low, special attention has to be paid to the section of the equalizing cables. When, however, these are once adjusted, they require no further attention. When switching out a dynamo, resistance is inserted in the field circuit until the machine gives only a small current, when the main switches are opened with very little arcing. By this method there is absolutely no blink in the lights, the machines which still remain in circuit taking up the additional load automatically, and by reason of the overcompounding adjust their voltage to suit the load. On account of the series turns, the commutators work practically sparkless and with very little movement of the brushes. This is largely due to the fact that the series turns increase the field magnetization in the air-gap just at the time when such increase is most required for sparkless commutation. The connections to the station now amount to more than the equivalent of 36,000 lamps of 8 cp.—Lond. *Elec.*, June 30.

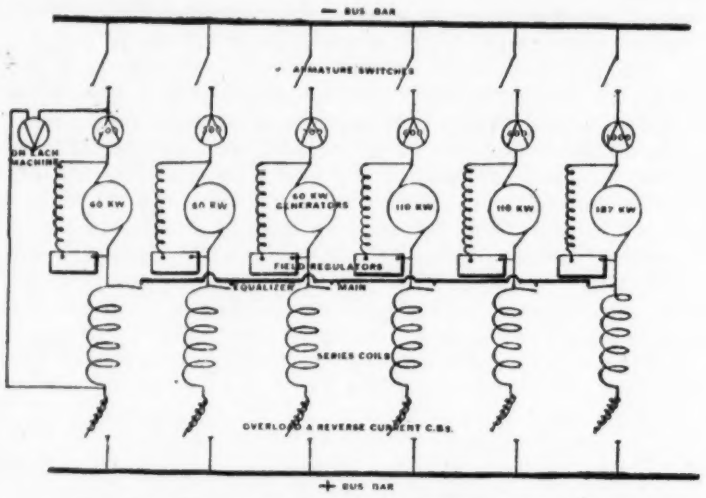


FIG. 2.—DIAGRAM OF GENERATOR CONNECTIONS.

Alternating-Current Boosters.—An illustrated description of variable-ratio transformers for boosting long low-tension feeders which supply some of the outlying suburbs of Sheffield, and for adjusting the voltage on the local circuits of the new generating station, which is situated at some distance from the center of the supply area, and in consequence has to be run at a pressure considerably in excess of that normally obtained at the feeding points. In the latter case there is provided a reversing switch which enables the shunt connections to be changed, and the booster used for raising or lowering the voltage, as may be required. The secondary winding of the variable-ratio transformer is divided into 16 equal sections from which tappings are taken to the contacts of the switch.—Lond. *Elec. Rev.*, June 23.

ELECTROPHYSICS AND MAGNETISM.

Temperature and E.M.F. in Thermocells.—PALME.—An illustrated account of tests made to determine within the temperature interval from 0 to 300° C. whether the e.m.f. is a linear function of the temperature. If this relation holds good, the combination is specially suitable for a thermoelectric pyrometer. The measurements were made with combinations of various chemically pure substances, and the results are given in three diagrams, the first giving relatively low e.m.f's (up to 2.2 millivolts at 300° C.), the second giving medium e.m.f's (up to 6 millivolts), the third giving high e.m.f's (up to 15 millivolts). The latter diagram is reproduced in Fig. 3, in which the abscissas represent degrees Centigrade and the ordinates millivolts. Curve 1 refers to the combination, platinum-carbon; 2, platinum-German silver; 3, platinum-iron; 4, nickel-silver; 5, nickel-iron; 6, constantan-copper; 7, constantan-iron. All the curves are approximately straight lines and 4, 5, 6, 7 give sufficiently high e.m.f's for use in practice without specially delicate instruments. In the other diagrams given in the article, the curves for copper-iron, silver-iron and zinc-iron are theoretically interesting, since they have a maximum at 220° to 240° C.; this maximum value is somewhat above 1 millivolt. The curves then drop again to values of 0.6 or 0.7 millivolt at 300°. Such combinations are, of course, unsuitable for thermoelectric pyrometers, since a certain e.m.f. may correspond to two different temperatures.—*Zeit. f. Elek.* (Vienna), July 2.

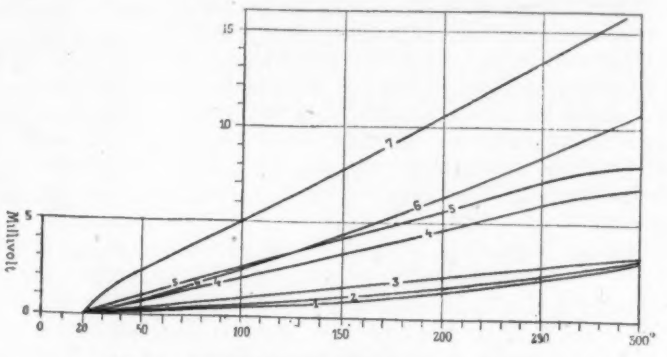


FIG. 3.—TEMPERATURE AND E. M. F. CURVES.

Positive Leak from Hot Platinum.—RICHARDSON.—An account of experiments in which the author determined the rate of leak of a positive charge from a platinum wire at various pressures of the surrounding gas. For a mean potential of 3.5 volts, the results at pressures below 1 mm. show a linear relation between the current and the pressure. Thus the leak consists of two parts, one of which is proportional to, and the other independent of, the pressure. Similar results were obtained with a potential of + 80 volts on the filament. The part of the leak which is independent of the pressure was found to be nearly independent of the potential over a range from 40 to 200 volts.—Lond. *Elec., June* 30; from *Proceedings Cambridge Phil. Society*, May 24.

ELECTROCHEMISTRY AND BATTERIES.

Thermochemistry of High Temperatures.—RICHARDS.—A continuation of his serial on metallurgical calculations. In the present installment very full numerical data are given concerning the specific heats and latent heats of fusion and volatilization of the different elements. As to the specific heat the law of Dulong and Petit is discussed. With respect to the latent heat of fusion the following rules are given: If the latent heat of fusion is expressed per atomic weight of the element (analogous to specific heat of atomic weight), and if they are plotted as ordinates with the melting points as abscissæ in a diagram, a straight line is obtained. Numerically, if the melting points be expressed in degrees of absolute temperature (Centigrade + 273), the latent heats of fusion of atomic weights average about 2.1 times the temperature of the melting point. This rule may be used to predict an undetermined latent heat of fusion. Another rule is that the continued product of the latent heat of fusion of atomic weight and the coefficient of expansion and the cube root of atomic volume (atomic weight divided by specific gravity) is a constant. If the coefficient of linear expansion between 0° and 100° C. is used, the constant is 0.095, or if the actual linear expansion of unit length from 0° to 100° C. is used, the constant is 9.5. The latent heat of vaporization of atomic weight is proportional to the absolute temperatures of the boiling point at atmospheric pressure, and is numerically equal to about 23 times that temperature. The experimentally determined values are given in forms of tables for all elements, arranged in the order of their atomic weights.—*Electrochem. and Met. Ind.*, July.

Lead-Antimony Alloys for Storage Batteries.—ROSSET.—The conclusion of his paper on quick methods for determining the composition of lead-antimony alloys for storage battery plates. In the present installment he describes how to determine the composition from the hardness of the alloy.—*Centralblatt f. Accum.*, July 1.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Direct-Current Motor Meter.—A fully illustrated description of a motor meter made by the Allgem. Elek. Ges. for currents between 3 and 100 amp. and voltages between 60 and 600 for two-wire and three-wire systems. The meter has been admitted for calibration by the Reichsanstalt and is now described by this bureau. The construction is shown in Fig. 4, while Fig. 5 shows the connections to a three-wire system. The braking disc, *B*, is a sheet of aluminum of 1 mm. thickness with a diameter of 112 mm. The auxiliary coil,

H, has an internal diameter of 36 mm. and an external diameter of 50 to 60 mm., and has a height of 10 mm. It consists of 3,500

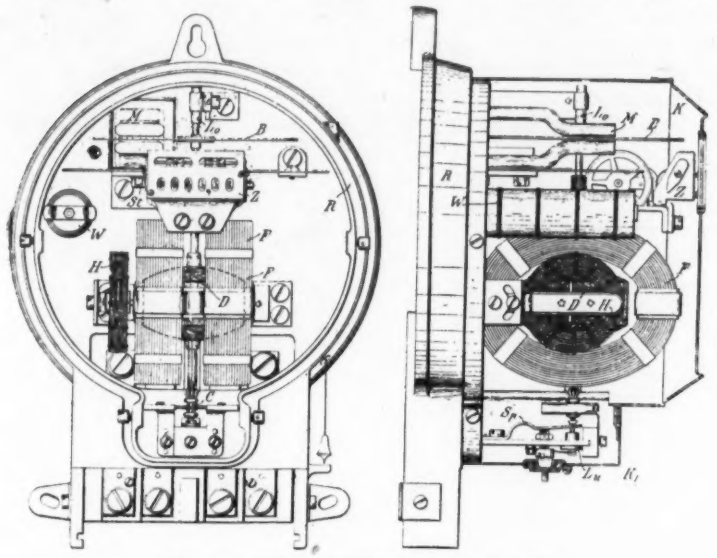


FIG. 4.—DIRECT-CURRENT MOTOR METER.

to 4,000 turns of copper wire of 0.09 mm. thickness. The resistance, *W*, consists of 0.05 mm. bare nickel wire and is so adjusted that

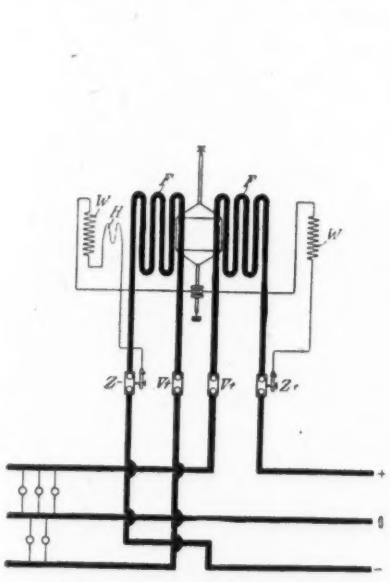


FIG. 5.—DIAGRAM OF CONNECTIONS.

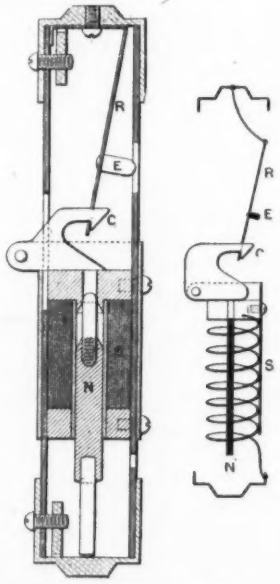


FIG. 6.—PROTECTING DEVICE.

0.0125 to 0.014 amp. passes through the shunt circuit.—*Elek. Zeit.*, June 29.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Electric Wave Transmission.—FRANKLIN.—A Franklin Institute paper on electric waves and the behavior of long-distance transmission in lines. The author makes use of Maxwell's cellular theory of the ether. He develops the conceptions of electromagnetic action on the basis of this theory and applies them to the discussion of electric waves along long lines. The reduction of line losses and of wave distortion by increasing line induction is explained. The author dwells on the usefulness of Maxwell's cellular theory of the ether, since there is scarcely a phenomenon of electromagnetic action which is not very greatly simplified by the use of these conceptions. His "advice to the younger readers is to swallow Maxwell's cellular theory and digest it, and do not turn away from it in disgust because some one says, truly, that it does not contain the secret of the universe."—*Jour. Franklin Inst.*, July.

Protection of Telephone and Telegraph Apparatus.—An illustrated description of a device by Van Deth of a French telephone company for protecting telephone and telegraph apparatus against currents of slightly increased strength. The device is shown in Fig. 6. It consists of a small solenoid, *S*, which, for a certain strength of current, attracts the small iron core, *N*. This then acts on the pivoted part, *C*, so that the spring, *R*, is released. By a slight pressure on *E* the apparatus is easily reset. The electric resistance of the solenoid is very small. The circuit is automatically broken. The solenoid has a small self-induction which has the advantage of forcing oscillating discharges through the lightning arrester.—*L'Industrie Elec.*, June 25.

BOOK REVIEWS.

ÉTUDE SUR LES RESONANCES. (A Study on Resonance in Alternating-Current Circuits.) By G. Chevrier. Paris: L'Éclairage Électrique. 76 pages, illustrated.

This little volume is a mathematical treatise on the elementary principles of resonance in simple alternating-current circuits with inductance and capacity in simple series or simple parallel connection. The treatment is somewhat academic in character and deals with the subject rather from the standpoint of the mathematician than from that of the engineer. The topic is dealt with neither historically nor by comparison with experimental results. The conditions of distributed inductance and capacity are barely touched upon. Consequently the theorems developed scarcely apply to long circuits. The book will interest students of mathematical physics.

EINLEITUNG IN DIE THEORETISCHE ELEKTRIZITATSLEHRE. Introduction to the Theoretical Study of Electricity. By Dr. Ignaz Wallentin. Leipzig: B. G. Teubner. 444 pages, 81 illustrations.

If there is anything noticeable about German publications, it is the careful and thorough manner in which German mathematical textbooks are written, corrected, printed and published. This volume is no exception to the rule. It is a carefully prepared mathematical textbook intended for advanced students. It is written from the algebraical and not from the vectorial standpoint.

The book is divided into six sections. The first deals with electrostatics, the second with magnetism, the third with electric currents, the fourth with electromagnetism, the fifth with electromagnetic induction and the last with electromagnetic units.

The treatment is clear and substantial, but follows the classical forms of the great authors of the end of the nineteenth century rather than the newer methods of lesser renown. The style is similar to that of Mascart and Joubert, after making allowance for the difference between the two languages. The book will interest the student of the higher mathematics and physics.

THEORIE DER ELEKTRIZITÄT. Electrical Theory. By M. Abraham and A. Föppl. Vol. 1: Einfuhrung in die Maxwellsche Theorie der Elektricität. Introduction to the Maxwellian Theory of Electricity. B. A. Foppl. Second edition Leipzig: B. G. Teubner. Cloth, 443 pages, 11 illustrations.

Although there are a number of treatises upon the mathematical theory of electricity, there are comparatively few dealing with that theory from the vectorial standpoint. This volume bases almost the entire mathematical treatment upon the theory of vectors. The theory is a sort of compromise between the Grassman Ausdehnungslehre and the Hamilton quaternions. The book is thorough and clearly developed, but is only intended for advanced mathematical students. It would be improved by an index of subjects. It possesses, however, a final tabular arrangement of formulæ which is very useful for reference.

There is no doubt that the method of treatment presented is of great analytical power, although somewhat unusual to American mathematical readers. The book will be of interest and value to advanced students of mathematical physics.

MAXWELL'S THEORY AND WIRELESS TELEGRAPHY. Part I: Maxwell's Theory and Hertzian Oscillations, by H. Poincaré; translated by Frederick K. Vreeland. Part II: The Principles of Wireless Telegraphy; by Frederick K. Vreeland. New York: McGraw Publishing Company. 255 pages, 145 illustrations. Price, $2.00.

This volume is a welcome addition to our scientific literature, as it meets a want that has been keenly felt in recent years when one hears so much about electromagnetic oscillators and detectors. Every one knows to-day that Clerk Maxwell was not only a high priest in the science of electricity, but also a seer gifted with extraordinary insight into the behavior of dielectrics and with extraordinary power in expressing the properties of the radiation emitted by alternating currents of high frequency. As seer, he predicted the discovery of electric waves and sought to express by a system of equations the laws that would govern them. But these equations, however, and

their discussion by Maxwell and others are not easy reading; they demand a mathematical outfit that requires for its weaving years of work by the university loom. Hence our gratitude to those accomplished mathematicians and physicists who, from time to time, have undertaken the task of interpreting the equations for us and showing their application to electrical and optical phenomena. Eminent among these interpreters is Poincaré, whose name is honored in every institution of learning the world over. A careful and discriminating student of Maxwell's theory, and also mathematical expounder of electric oscillations and associated phenomena, few men were as well qualified as Poincaré to translate Maxwellian views into the ordinary language of the physical laboratory. This he did in a booklet of the *Scientia* series, and it is this booklet which Mr. Vreeland now presents to English readers in the first part of the present volume. The accuracy of expression and clearness of exposition that characterize the original are faithfully reproduced in the translation. Not only so, but Mr. Vreeland has greatly enhanced the value of the little treatise by the numerous diagrams and accompanying explanations with which he illustrates every knotty point of the text. We find five figures in the original work and fifty-six in the translation. Many of these are very helpful and suggestive, e. g., Fig. 45, which shows a portion of the spherical wave proceeding from an oscillator, and Fig. 46, which shows the wave front surrounding a wire transmitting electric oscillations.

Part II, from Mr. Vreeland's own pen, is mainly of a practical character showing the rise and progress of the art of electric signaling through space without wires, although the function of the aerial and the grounded wire as well as the physical nature of the waves sent out are fully discussed.

Part I occupies the first half of the book. In this part a physical explanation is given of the ordinary electrical phenomena in accordance with Maxwell's theory, and whenever possible mechanical analogies are given to make clear and to show the corrolation of the electrical phenomena. The distinction between conductors and dielectrics is well shown. Conduction currents in conductors are compared to the motion of a body immersed in a viscous liquid, and just as this motion will continue so long as the moving force exists, so conduction currents continue so long as the electromotive forces which produce them exist. Displacement currents in dielectrics are compared to the motion of a body against the elastic reaction of a spring, and just as such motion continues only until the force of the reaction is equal to the force applied, so the displacement current continues only until the reacting e.m.f. of the dielectric is equal to the applied e.m.f. This conception is made exceptionally clear in this book and is used later to give simple explanations of the phenomena of wireless telegraphy.

Chapters IV and V deal with the experiments of Hertz, which confirmed the mathematical results obtained twenty years before by Maxwell. These chapters are very clearly illustrated, and the methods for obtaining the rapid electrical oscillations and for detecting them and measuring their wave lengths are explained in detail.

Propagation of electrical waves along a conductor is taken up in Chapter VI. The diffusion of the current due to ohmic resistance is compared to the spreading of a caravan along a road by the lagging behind of the followers. The conduction of a continuous current along a wire is also taken up. The next chapters deal with wave length and multiple resonance of electric waves in air and in dielectrics. The last two chapters of Part I explain the relation between electric waves and light. It is here shown that these differ essentially only in the length of the waves, and that they both travel through space at the same velocity. It is also shown that all the phenomena of optics can be reproduced with electric waves.

Part II, discussing wireless telegraphy, occupies the second half of the book. In Chapter I general principles are taken up. It is here shown how the phenomena and principles explained in Part I may be applied to understand the problems of wireless telegraphy. Three methods are described which may be employed to signal through space: (1) By electrostatic induction, (2) by electromagnetic induction, (3) by electromagnetic waves. It is explained that the last is a complex phenomenon which includes the effects of the two others.

Each one of the three methods is clearly illustrated by means of a hydrostatic analogy. Examples of actual experiments in signaling through space by each one of the three methods are also given. It is then explained that the electric wave method is the only one that can be used for transmitting over practical distances.

In Chapter II a number of the early experiments in telegraphy through spaces by means of electric waves are explained, including the historical ones of Marconi. The general course of development is clearly indicated, including the introduction of the antenna. The grounding of the antenna and the variations in its form to increase the radiations and make it suitable for very great distances are discussed in the next chapter. The use of high-power generators for long-distance signaling is then discussed and the diagrams of various forms of sending circuits are given. Chapter II presents a remarkable discussion of the propagation of waves from a grounded antenna. Three hypotheses are offered: (1) That they are free waves in the ether exactly like those studied by Hertz; (2) that the transmission is by alternating currents in the ground or sea and is independent of ether waves; (3) that the transmission is by guided waves of a peculiar character, which glide over the surface of the earth or sea.

Experiments are described which prove that each of the hypotheses has some foundation in fact, but the last one is stated to be the only one which completely explains the phenomenon. Chapter V deals with the receiving apparatus. Five types of detectors are described and the advantages and peculiarities of each type are pointed out. Various arrangements for the receiving circuit are also given. The last chapter is on selective or tuned signaling. The physical principles involved are first briefly discussed, and a number of mechanical analogies and light analogies are given to illustrate these principles.

A number of early experiments in tuning are then given, and the development is outlined leading to the various systems in use at present. Various arrangements for multiplex signaling are also discussed. In conclusion the author states that the problem of wireless telegraphy has now passed through the hands of the prophet, the mathematician, the physicist and the practical experimenter, and that it is now in the hands of the engineer and the financier.

Taken as a whole, the book affords a thoroughly clear exposition of ordinary electrical phenomena and of the principles involved in wireless telegraphy. In addition to this the book gives the development of the art of wireless telegraphy from the early laboratory experiments to the commercial stage it has reached at the present time. Being free from mathematics, the book affords comparatively easy and exceedingly interesting reading, which will prove of value not only to those desiring a knowledge of wireless telegraphy, but also to everyone desiring to get a clearer understanding of the ordinary electrical phenomena met in every-day practice.

BOOKS RECEIVED.

DIE FERNLEITUNG VON WECHSELSTROMEN. By Dr. G. Roessler. Berlin: Julius Springer. 243 pages, 60 illustrations. Price, 9 marks.

HYPOCHLORITE UND ELEKTRISCHE BLEICHE. By Dr. Emil Abel. Halle: Wilhelm Knapp. 110 pages, 10 illustrations. Price, 4.50 marks.

DAS FUNKEN VON KOMMUTATORMOTOREN. By F. Punga. Hannover: Gebruder Janecke. 142 pages, 69 illustrations. Price, 4.60 marks.

DAS ELEKTRISCHE BIGENLICHT. Second Edition. By Walther Biegon von Czudnochowski. Leipzig: S. Hirzel. 194 pages, 36 illustrations. Price, 4 marks.

DAS ELEKTRISCHE BIGENLICHT. Third Edition. By Walther Biegon von Czudnochowski. Leipzig: S. Hirzel. 95 pages, 36 illustrations. Price, 4 marks.

GROSS-GASMASCHINEN. By Dr. A. Riedler. Berlin: R. Oldenberg. 192 pages, 130 illustrations. Price, 10 marks.

LE FOUR ELECTRIQUE. By Adolphe Minet. Paris: A. Hermann. 76 pages, illustrated. Price, 5 francs.

INSTRUMENTE ZUR MESSUNG DER TEMPERATUR FÜR TECHNISCHE ZWECKE. By Otto Bechstein. Hannover: Gebruder Janecke. 64 pages, 61 illustrations. Price, 1 mark.

DIE FORMELZEICHEN. By Olof Linders. Leipzig: Jah & Schunke. 96 pages, illustrated. Price, 5 marks.

ELEKTRISCHE KRAFTUBERTRAGUNG. By Wilhelm Philippi. Leipzig: S. Hirzel. 386 pages, 326 illustrations. Price, 18 marks.

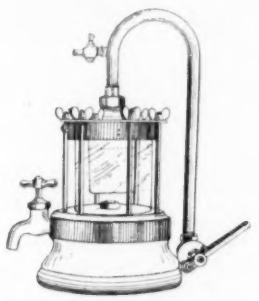
DIE ELEKTRISCHEN DRUCKKNOPFSTEUERUNGEN FÜR AUFZUGE. By A. Genzmer. Hannover: Gebruder Janecke. 166 pages, 180 illustrations. Price, 6 marks.

LES ENROULEMENTS MODERNES. By A. Meynier and H. Nobiron. Paris: Ch. Beranger. 53 pages, 41 illustrations.

THE TELEGRAPHIST'S GUIDE. By James Bell and S. Wilson. London: S. Rentell & Co. 227 pages, 197 illustrations. Price, 50 cents.

Electric Water Purifier.

An ingenious device in which electricity is used to assist in purifying water is illustrated in the accompanying cut. The predominating characteristic of the apparatus is its extreme simplicity, as will be appreciated from the description below. The device, which is attached to the ordinary service pipe, allows the water to pass slowly through it after all matter held in suspension has been precipitated and the bacteria have been killed and removed. The water enters first a central aluminum cup from which it can escape through numerous small holes, only after it has passed through a filter cloth made of heavy felt. Surrounding this cup is a second outer aluminum cup through the perforations in which the water flows after it has passed through a second felt filter. Between the two aluminum cups is maintained an e.m.f. sufficient, it is said, to render innocuous all germ life and to remove all metallic salts, oxides, nitrates, saline solids and other matter which may be in solution. It is stated that the water which is drawn from the receptacle is perfectly sterilized and free from all deleterious matter injurious to health.



ELECTRIC WATER PURIFIER.

The containing vessel for the aluminum cups consists of a glass cylinder with hard-rubber end pieces, the contact surface between the hard rubber and the glass being formed by a substantial sheet of rubber packing. Short rods of metal, which pass through the upper end piece, serve for connecting the aluminum cups to binding posts. The switch for controlling the electric current passing through the cups is mechanically operated by the handle of the valve for admitting water to the purifier. The switch is closed only when the water is flowing through the purifier. By means of an adjustable stop on the regulating valve, the rate of flow of water can be set to any desired amount, so that when the valve is in its "on" position the electric current is turned on and the proper amount of water passes through the purifier.

Contrary to the usual belief, it has been ascertained that the e.m.f. necessary to remove the germs is quite small—in fact, less than ten volts is sufficient. The source of e.m.f. can be the usual electric light circuit, in which case the apparatus is connected in series with a single lamp; or a battery composed of six dry cells can be used for this purpose. It has been found that six commercial dry cells, which can be bought at an insignificant price, will supply sufficient electrical energy to purify all of the drinking water that is required by an average family for six months. The device is handsomely made of glass, hard rubber and nickel-plated metal.

Numerous purifiers have been in successful use for some months past. The apparatus is now being placed upon the market by the Electric Water Purifier Company, 52 Broadway, New York.

Portable Wireless Telegraph Sets.

Among the numerous applications for wireless telegraphy, not the least important is the coast defense service. For this work there have been developed special portable wireless instruments, a description of which we are able to give below. The whole equipment, with batteries and instruments, weighs less than 250 pounds, and it is so sub-divided that it can be handled easily by two men. The apparatus can be completely installed in less than thirty minutes, and can be dismantled in fifteen minutes.

The portable set consists of four units, each of which is provided with shoulder straps, besides the battery, vertical wire and antenna.

FIG. 1.—INSTRUMENTS IN USE AT FORT HANCOCK STATION, SANDY HOOK.

These units, which may be designated as the transformer unit, the transmitting unit, the condenser unit, and the receiving unit, are shown with their cases in Fig. 1.

The initial source of energy is a storage battery, which consists of 12 cells arranged in three cases of four each. The power used is approximately 4 amps. at 20 volts. The batteries will stand a charging rate of 8 amperes for 10 hours. In the receiving circuit there are used dry batteries having a normal working pressure of from 1.2 to 1.5 volts.

The wave detector is of the filing-coherer type, the filings being arranged magnetically. The coherer gap is sub-divided so as to make a multiple surface of the electrodes at the gap. By means of an adjustable resistance arranged on each side of the coherer circuit it is possible to vary the sensitiveness of the coherer circuit at the filing gap. In connection with the coherer is used a relay. The circuits are so arranged that when the electric waves act upon the coherer, it closes the circuit to the relay, which operates an "attention bell," and simultaneously energizes an electromagnet, which serves to restore the filings in the coherer to their initial condition.

For the continuous reception of signals in actual service, there is mounted at the front of the receiving case a simple multiple

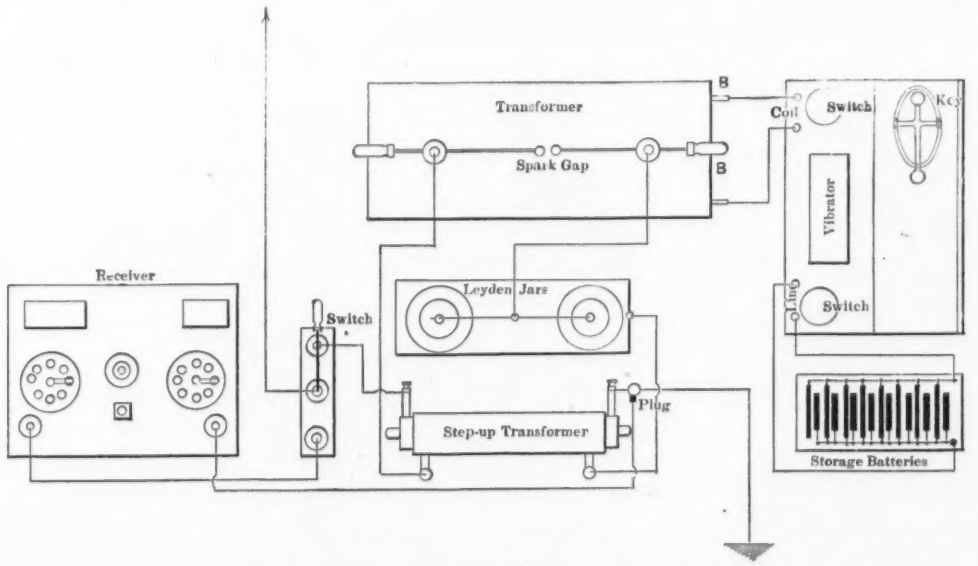


FIG. 2.—DIAGRAM OF CONNECTING CIRCUITS.

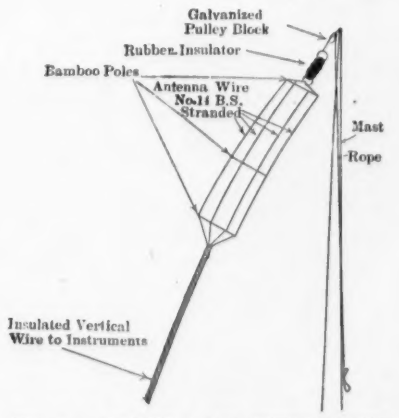


FIG. 3.—ANTENNA AND VERTICAL WIRE.

steel, carbon and mercury microphone receiver, which is connected through a spring jack and plug to a pair of head telephones.

A single-pole, double-throw switch shown in the diagram of circuits, Fig. 2, serves for connecting the antenna to either the transmitting or receiving apparatus. For the antenna there is provided about 500 feet of No. 14 bare stranded wire, specially tinned. The method of connecting the antenna and the vertical wires is indicated in Fig. 3. The circuit to ground is made through a wire cloth or netting, which can be spread out on the ground or dropped into the water, as conditions may require.

The tests of these equipments in actual service have proved so satisfactory that the signal corps of the U. S. Army has ordered twelve complete sets, which are now being installed for the Artillery Coast Defence by the Clark Electrical Engineering Company, of Detroit, Mich.

New Independent Telephone System for Meridian, Miss.

One of the strongest organizations to take up the work of developing the independent telephone field in the South, is the New Home Telephone Company, of Meridian, Miss., and the interests represented by Messrs. Jones & Winter, contractors, of Chicago.

From Meridian, where the first plant will be installed, it is proposed to extend the system throughout the State and adjoining territory, building plants in all of the principal cities now undeveloped by independent operating companies.

The Meridian plant will consist of a 4,800 line capacity, full central-energy system, equipped for the immediate operation of 1,200 lines. The construction will be a full cable system with underground conduits, and poles conveniently located for distribution.

The entire apparatus and equipment is being furnished by the International Telephone Mfg. Co., of Chicago. The central office equipment will be of their latest design, a full multiple lamp line signal board with double supervisory clearing-out signals and their new four party line apparatus with indicating selective keys in each cord circuit. There will be a full cable system of line construction.

Concentric Diffuser for Incandescent Lamps.

The incandescent concentric diffuser recently designed by the General Electric Company and illustrated herewith will prove of great interest to those who have in the past been bothered by the problem of securing adequate illumination under mezzanine floors, in basements and similar places, where low studding eliminates the arc lamp and large area the separate incandescent lamp. Grouping incandescent or Meridian lamps necessitates, for the best results, a reflector with the widest possible range of lower hemispherical distribution. This the new incandescent concentric diffuser, with its corrugations of progressively increasing amplitude, appears to furnish. The diffuser is 26-in. in diameter, and is made of steel, coated with high-grade Austrian air-dried enamel, which, does not turn yellow, but becomes whiter with age. The black deposit which

FIG. 1.—CONCENTRIC DIFFUSER.

usually accumulates on the ceiling above the lamps is received by the diffuser, from which it can be readily washed off, so that the diffuser protects the ceiling, in addition to giving an excellent distribution of light.

The diffuser can be installed near the ceiling or on any extension rod, and any standard make of cluster with 4-in. base can be used. The best effects have been obtained with one 25 or 50-cp Meridian lamp in the lower socket, and 3, 4 or 5 standard frosted 8, 16 or 32-cp. incandescent lamps, set radially, as shown in the accompanying illustrations.

From the chart it will be seen that the lower hemispherical candle power has been increased about 40 per cent, and that the general distribution of downward light has been greatly improved.

FIG. 2.—CONCENTRIC DIFFUSER.

The radial lines shown in the chart correspond to angles of 10 degrees in elevation, being marked in degrees of arc above and below the horizontal. The distance along these lines from the center to a point on the curve represents the intensity of candle-power in that direction. For instance, referring to the solid line curves, we find that at 60 degrees below the horizontal the cluster alone gives 85 candle power. When the diffuser is used this is increased to 136 candle power, showing a gain of 60 per cent in this particular direction. While it is not advantageous to have all the light concentrated directly beneath the lamp, it is obvious that the most useful light is that thrown below the horizontal and that the light thrown above the horizontal cannot be utilized except as it is reflected downward from the ceiling.

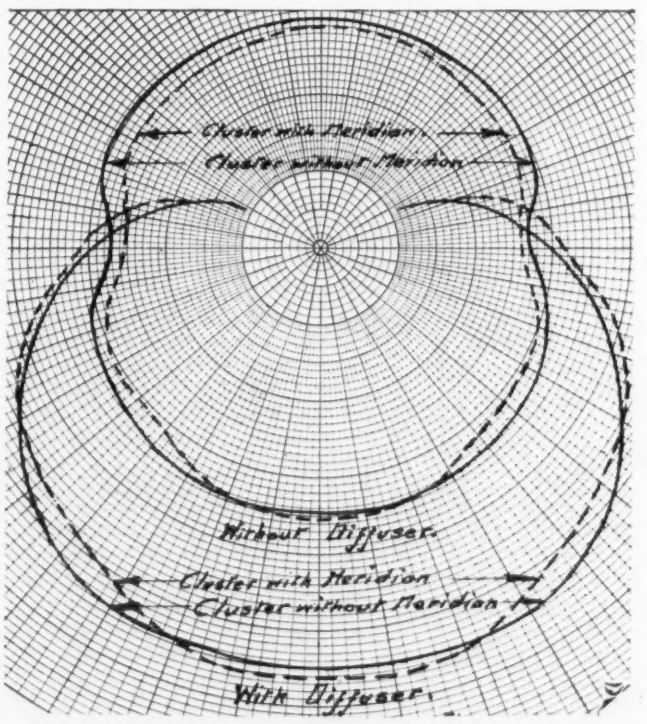


FIG. 3.—ILLUMINATION CURVE.

Recent Developments in Induction Motors.

The Westinghouse type HX motor is designed for constant-speed service and belongs to that class of induction motors without contacts or any connection whatever between the supply circuit and the rotating element. The starting mechanism, which is mounted on the shaft external to the frame, consists of a device by means of which resistance is inserted in the winding of the revolving part when starting and gradually cut out as the speed increases until the winding is short-circuited. Thus, by a gradual development the

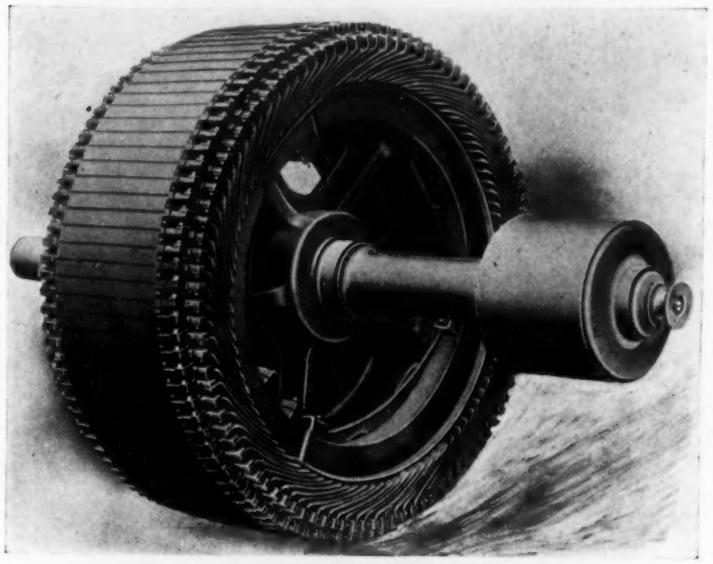


FIG. 1.—SECONDARY COMPLETE WITH STARTER.

starting current becomes practically the running current, which is a very important feature on small systems where the voltage, which should be kept constant, would be considerably affected by connecting the motor suddenly to the line.

The frame of the motor is a solid ring of cast iron with feet for supporting the machine. The core carrying the stationary windings is built up of steel punchings which exactly fit the bore of the frame, and which are firmly held together between two iron rings. Substantial brackets carrying the bearings for the rotating element are bolted to the cast-iron frame, and may be fastened in four positions,

FIG. 2.—INDUCTION MOTOR FOR USE ON WALL.

permitting the motor to be mounted on the floor, sidewall or ceiling, and the oil reservoirs always to be in the proper position. By means of oil rings revolving in the reservoirs, copious lubrication is provided for the motor while in operation.

To secure the starting characteristics above mentioned the secondary windings are similar to those of a polyphase generator. Insulated copper bars are inserted in the partially closed slots in the steel punchings of the rotor. These punchings are mounted on a cast-iron spider which is keyed to the shaft. The overhanging tips of the teeth hold the bars in the slots. The end connectors are secured to the bars after they are in place and the leads are brought out through the hollow shaft to contacts in the starting device. This device, which consists of a resistance which is cut in and out of the circuit by a sliding contact, is so arranged that as the motor accelerates the resistance may be gradually cut out by pushing in the cylinder, until for normal running the winding is short-circuited. In this movement the resistance is cut out by what amounts to an infinite number of steps. The starting device may be operated by a lever rigged in a manner similar to an ordinary belt-shifting device.

The case of the starter, which is a cast-iron cylinder of enclosed construction, being dust-proof, and the starter being sparkless in operation, the motor may be used with impunity in the presence of inflammable vapor or dust-laden air.

These motors are built for two and three-phase circuits in sizes from 5 to 50 hp, for 3,000 and 7,200 alternations. Standard voltages are 100, 200 and 400 for machines up to 20 hp, and 200 and 400 volts from 20 to 50 hp. The motors retain a high efficiency even on light loads; therefore, their all-day efficiency is very high, because in general service motors may operate on light loads much of the time. The drop in speed between no load and full load has been found by

A new type of polyphase induction motor, shown in Fig. 3, has recently been placed on the market by the Westinghouse Electric & Mfg. Company, which is designated as type CCL. These motors are manufactured in sizes from ½ to 75 horse-power, and are wound for operation on two or three-phase circuits at voltages of 200 and 400 for all sizes except the ½ horse-power. The sizes from ½ to 5 horse-power inclusive are also wound for 100 volts.

The frame of the motor consists of a solid, cylindrical cast-iron yoke to the ends of which are bolted brackets, which carry the bearings. These brackets are open so as to provide good ventilation, and may be fastened to the frame in any of four different positions, making the motor sutable for floor, wall or ceiling mounting. Motors up to and including the 5-horse-power have solid brackets and bearings, with slotted holes in the feet for adjusting the tension of the belt. Larger machines have the brackets and the bearings split horizontally, greatly facilitating the removal of the bearings should this become necessary. Belt adjustment on these motors is made by tension screws which shift the motor on a cast-iron bedplate.

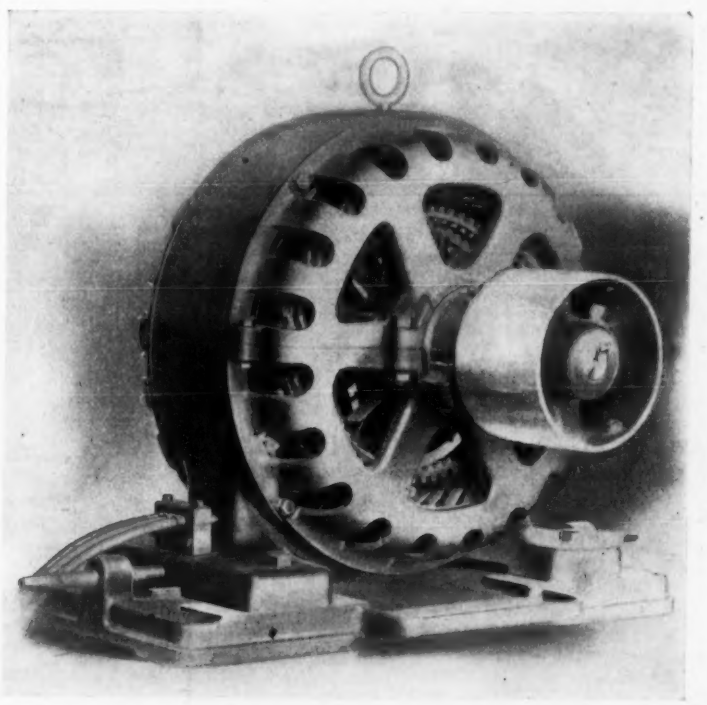


FIG. 3.—POLYPHASE INDUCTION MOTOR.

There are no wearing parts on the machine except the bearings, and as these are of ample dimensions, with a light rotor and flooded lubrication maintained at all times by means of oil rings, the wear is exceedingly slight.

The stationary part of the motor is the primary element which is connected to the source of current. The magnetic circuit consists of circular laminations of sheet steel, securely keyed into the cast-iron frame. Terminal leads are brought out at the base of the frame, being held in a cast-iron cleat. Hand connectors, or knuckle joints,

such as are supplied with railway motors, are used to connect the motor to the supply circuit.

The secondaries of these motors are of the squirrel-cage type, a construction which is extremely simple, rigid and durable, and which

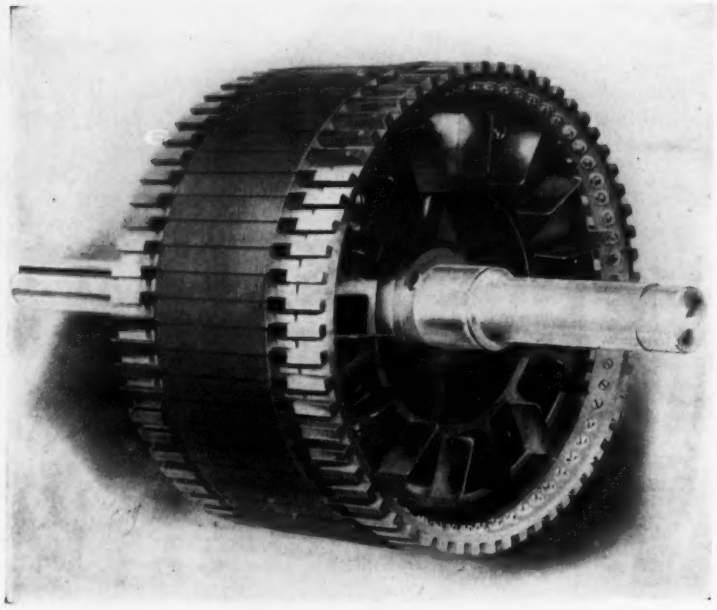


FIG. 4.—SQUIRREL-CAGE SECONDARY.

has given universal satisfaction. The winding consists of square copper bars lying in partially closed slots and bolted at the ends to metallic rings of ample surface to dissipate the heat generated in them. For the ½-hp motor are used round bars which are riveted to brass or copper rings at each end.

The design and principles governing the construction of these motors are particularly favorable to maintaining good efficiencies at low loads, which insure a high all-day efficiency, as in general service motors may operate at light loads much of the time. The motors, following the precedent established by type C Westinghouse induction motors, are provided with liberal bearings and shafts, and adjustment of the bearings is unnecessary.

Types of De Laval Turbine Units.

Some four hundred De Laval turbine generators are now in service, ranging through a wide variety of sizes and styles. Subjoined will be found data in regard to the leading types made by the De Laval Steam Turbine Company, of Trenton, N. J., to whom we are indebted for this interesting data.

The direct-current turbine generators range in sizes from 4.6 to 200 kilowatts, and the alternating-current turbine sets from 10 to 200 kilowatts. The direct generators of 50-kw capacity and over are

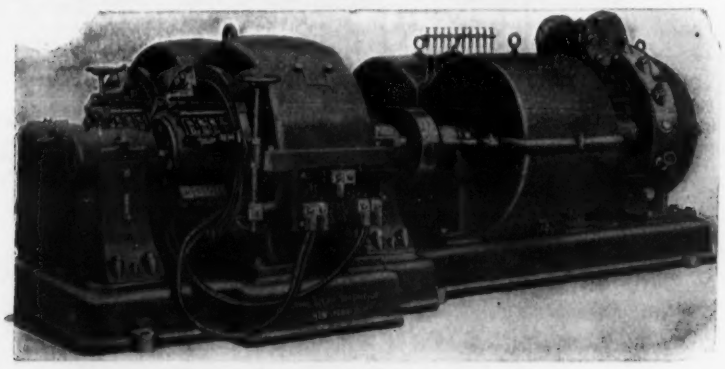


FIG. 1.—200-KW, DIRECT-CURRENT UNIT.

of the two-armature type. Fig. 1 illustrates a 200-kw, direct-current unit. As will be seen, the frame encircles both armatures. This type of generator presents a very flexible arrangement as regards the electrical end, as the generators can be connected either in series or parallel, can be run on two or three-wire system; or the turbine dynamo can be run in parallel with other engines and generators of either 125 or 250 volts. The turbine generators of 35 kilowatt capacity and under are of single armature type, Fig. 2 illustrating a 20-kw, direct-current unit. The peripheral speed of the commutator of the 200-kw generator does not exceed 2600 ft. per minute, and of the 20-kw generator 3500 ft. per minute, which is not excessive, thus insuring sparkless running from no load to 25 per cent overload, without shifting the brushes.

Fig. 3 illustrates 200-kw, revolving field, 2300-volt, 3-phase, turbo-alternator set, with direct-connected exciters. This unit consists of two entirely separate generators of 1150 volts each, armature and fields separately in series, using one field rheostat for both machines, as the two machines are rigidly connected through the turbine gears and pinion. They are very carefully set in phase at the shops, and are, therefore, always in step. The armatures can be connected

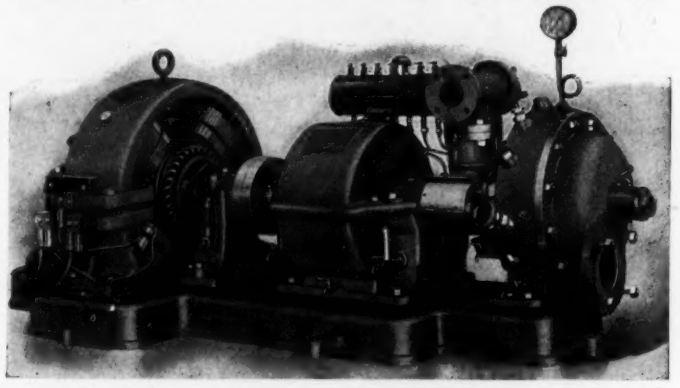


FIG. 2.—20-KW, DIRECT-CURRENT UNIT.

in series, or parallel, depending upon the line voltage required, and the fields can be connected according to the voltage of the exciting current. The exciters can be direct connected to the alternator shafts, as shown, or belt driven; or a separate turbine exciting set may be used.

Turbine alternators of 35 kilowatt capacity and under are of the single type; that is, the turbines are single-geared, and only one generator is employed. As is well known, a turbine driven alternator is an ideal unit for parallel operation, and the type of steam nozzle used in the De Laval turbine presents a very convenient method of synchronizing, as the speed of the incoming machine can be regulated entirely with the nozzles, as also the load after the machines are in step, not depending upon the throttle valve at all.

In the factory where these machines are built, there are several tracks leading from the erecting shop into the testing room, for the different machines, each track having its own switchboard, which is arranged for testing direct-current generators and motors, and single, two or three-phase alternators. Each switchboard is connected, through lead-covered cables laid in ducts, to a main cable board, which in turn is connected to the water rheostats and to the shop generator. At the cable board any track switchboard can be connected either to the shop generator, or to any of the water rheostats. The water rheostats are placed outside the testing room, and consist of iron tanks and plates which can be raised and lowered at a point near the machine being tested.

Every generator and motor is given a heat run, which consists of running the machine at full load until the temperature has risen

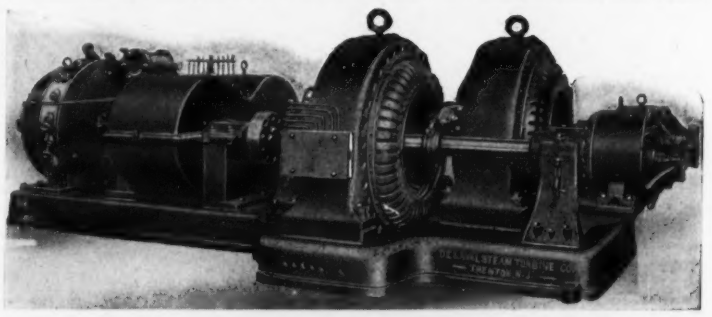


FIG. 3.—200-KW TURBO-ALTERNATOR SET.

to a steady point, temperatures being taken by thermometer and by resistance. The machine is then run at 25 per cent overload and temperatures taken. During these runs the brushes are set in their proper position and marked, and any defects are corrected. The compounding is gone over very carefully, insulation resistance is tested, all measurements are taken for efficiency tests, and any special test desired can be made.

The centrifugal pumps manufactured by the De Laval Steam Turbine Company are either turbine or electric motor-driven, using direct

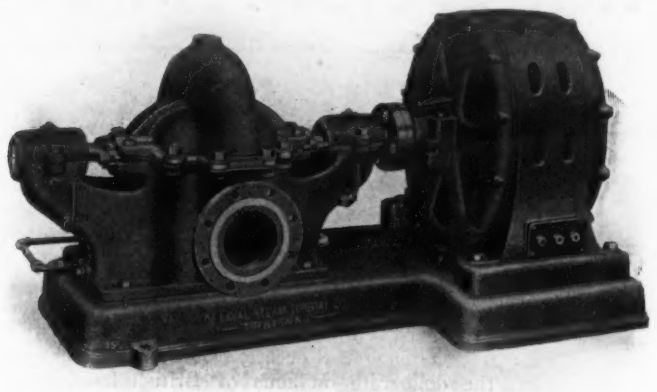


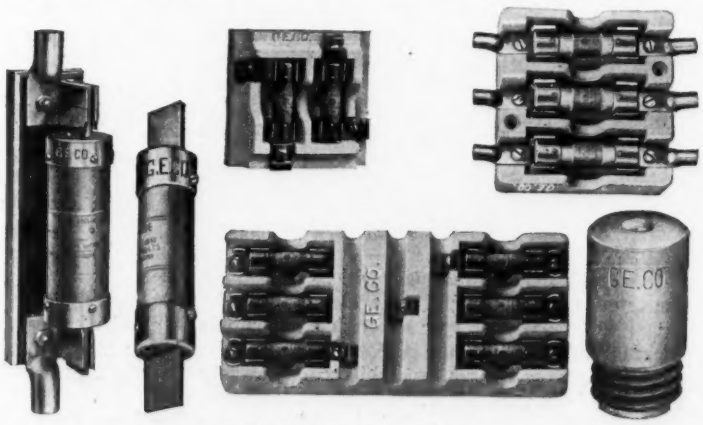
FIG. 4.—CENTRIFUGAL PUMP DRIVEN BY 75-HP ALTERNATING-CURRENT MOTOR.

or polyphase motors. In case the pump is required to give a variable quantity of water without throttling, a special regulator is installed in connection with the motor. Fig. 4 illustrates a De Laval 75-hp alternating-current, electric-motor centrifugal pump.

National Electrical Code Standard Enclosed Fuses and Cut-Outs.

The General Electric Company is now furnishing a complete line of National Electrical Code Standard enclosed fuses and cut-outs, ranging from 3 to 600 amp. for 250 and 600 volts. The cut-outs and fuses are uniformly compact and durable, and the insertion or removal of the fuses is easy and safe. For fuses rated from 3 to 30 amp., 250 volts, cut-outs similar to the Edison plug cut-outs are furnished, and for fuses from 31 to 60 amp., 250 volts, two and three-wire main line and single branch cut-outs are supplied. All other sizes of fuses are provided with single-pole cut-outs. With all cut-outs are used the General Electric wrought-copper cable terminals with the exception of the 30 amp., 250-volt sizes. These are provided with washer and screw terminals.

The fuses are of the well-known enclosed fuse type, ferrule or knife-blade contacts being used, according to the requirements of the code. The knife-blade type, in addition to the standard parts, has a brace placed in each end of the tube to engage the screws



FUSES AND CUT-OUTS.

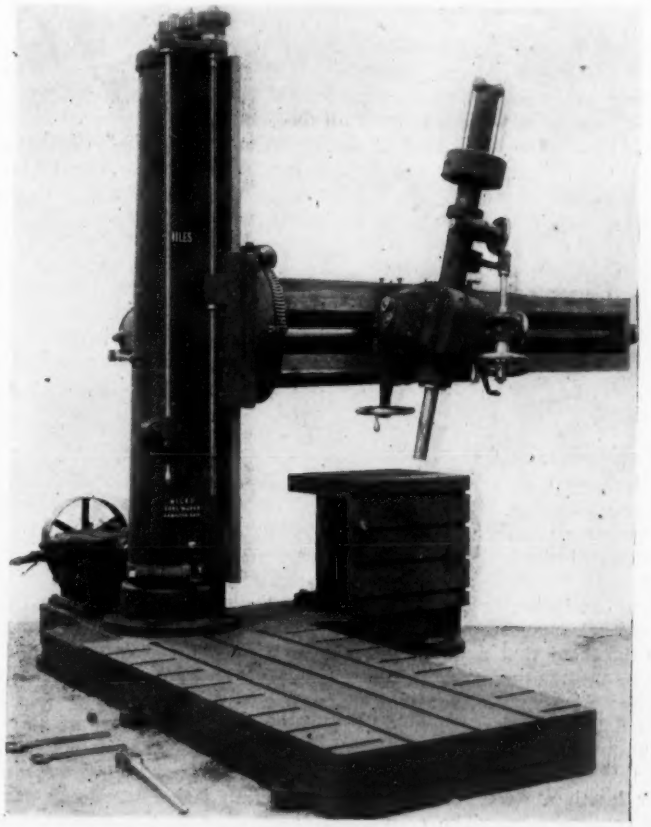
which hold the end caps in place. The brace is rigidly attached to the contact blades. This forms a strong mechanical joint which does not depend solely upon the shearing strength of the fibre tube. The knife-blade contacts are of punched copper, and when used with the standard switch clips provide the best form of contact. The parts being copper of high conductivity, generously proportioned, the heating is reduced to a minimum. In the ferrule type the contacts are made of phosphor-bronze clips designed to give the utmost contact and elasticity in the smallest possible space.

The renewable fuse plug consists of a brass tube with the lower end threaded to fit the standard screw shell, and the upper part insulated by a porcelain shell. There is also in the upper end a spring clip which receives the ferrule contact of the reload, the ferrule on the other end forming the center contact of the plug. The reloads are the 30 and 60-amp., 250-volt enclosed fuses.

New Drilling Machine.

The 6-in. universal radial drilling machine shown in the accompanying illustration is built to use high-speed drills to their fullest capacity. The drill-head saddle fits between as well as outside of the arm guides, which completes the double box section of the arm and insures great rigidity. The column saddle is strongly gibbed to flat-scraped bearings on the column, and the post, about which the column revolves, extends to the extreme top of the sleeve. The use of large shafts, steel gears, bronze bushings and ring oiling bronze bearings for all fast running shafts makes the machine capable of standing the hardest service. The principal feature of this machine, however, is its convenience and ease of manipulation. All the feeds and speeds are changed by means of levers, and great care has been taken to arrange the levers and hand wheels so that they shall be within easy reach of the operator. The column rests on ball bearings. An idea of the simple compact design of the machine can be gained from the photograph.

The machine is adapted for use with either carbon or high-speed drills, the range of spindle speeds being sufficient for this purpose. Friction clutches are used for starting and stopping the machine at high speeds, so as to prevent shock and consequent wear. The speed box is planed on the top, in order that the drill may be easily changed from a belt-driven machine to a motor-driven machine, by the simple substitution of two gears for the pulley. Reversing gears for tapping



UNIVERSAL RADIAL DRILLING MACHINE.

are provided. All speeds and feeds may be changed while the machine is running at its highest speeds.

This radial drill is a full universal machine; that is, both the arm and the saddle swivel. This fact should be borne in mind in considering the design. Dimensions of machine are as follows: Drills to center of 2 in.; maximum distance from face of column to center of drill, 77.5 in.; least distance from face of column to center of drill, 22.5 in.; greatest distance from spindle to base plate, 72 in.; traverse of spindle, 20 in. This machine is manufactured by the Niles-Bement-Pond Company, 111 Broadway, New York.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The hot weather tended to retard productive activity, but accelerated the consumption of seasonable merchandise, and had a beneficial effect upon the crops, which are now in a satisfactory condition. Inquiries indicate a general disposition to provide for a large volume of fall and winter business, clothing manufacturers receiving liberal orders from traveling salesmen, while cancellations are exceptionally few. Real estate transfers are large and building operations numerous, often overtaxing facilities for delivery of lumber and other materials. There is comparatively little interruption from labor disputes, and the net result in all commercial and manufacturing branches is exceptionally satisfactory for this midsummer period, which is usually the dullest of the year. Evidences of revival are discerned in those departments of the iron and steel industry that have lain dormant for some time, notably the pig iron division, which has been compelled to cut down production because of rapidly accumulating stocks at furnaces. A better feeling exists in bars and sheets, and stocks of wire goods are reported smaller than some time ago. The bituminous coal trade reports some depression in the Western fields, and summer shutdowns are expected in the anthracite region. Manufacturers of cotton goods find difficulty in filling orders for immediate delivery, but future business is most unsatisfactory. Money has been remarkably easy for this season of the year, considering the nearness of crop moving requirements. Railway earnings are favorable, those for the first half of July showing 7 per cent gain on 1904. The number of business failures for the week ending July 20, as reported by *Bradstreet's*, was 165, against 166 the week previous, and 190 in the corresponding week last year. The copper market continues active, with a good business for both home trade and export. There was a slight advance in prices, Lake closing at 15 to 15⅛c; electrolytic, 14⅞ to 15c.; cathodes, 15⅝ to 15¾c., and casting stock, 14½ to 14⅝.

THE COPPER MARKET.—The "Copper Gossip," of the National Conduit & Cable Company, under date of July 21, says: "There has been an exceedingly active market in copper lately, with demand from domestic sources specially pronounced. Europe also continues to take a lively interest in the trend of affairs here, but as far as recent buying is concerned this country occupies the first rank. Orders have poured in from home consumers in rapid succession, and the enormous size of the aggregate demand since the 10th inst. is clearly indicative of an excellent state of trade now under way. Large sales have been effected at 15 to 15¼ cents for both Lake and electrolytic, and it is significant to note that purchases of liberal quantities were made for deliveries up to the end of the year. Prompt delivery is quoted at 15¼ and business reported thereat. The general tendency of events in connection with copper and the underlying tone all point with emphasis to the remarkable strength of the situation. Notwithstanding the heavy tonnage disposed of during the past ten or fifteen days prices have not been sharply advanced. Indeed, there does not appear to be any disposition to raise prices to an unreasonable level, or put quotations at what might be considered abnormal heights. The important developments taking place in copper may possibly stimulate the market later, as it cannot be expected that a commodity in such urgent request as copper is will continue to remain at a stationary value for an indefinite period. A wonderful outlet for raw copper exists, and in spite of the large current production there is little chance left for the metal to accumulate in dangerous quantities. Europe and America are putting in their claims for monster supplies which are absolutely necessary for legitimate trade needs, and production is being closely pressed by consumption. The conviction is growing that the market is in for an extended period of firmness, and no one can carefully study the situation without being impressed with the surprisingly strong position of copper at the different strategical points. As matters look now it would appear to be the part of a wise conservatism to prepare for a hardening tendency before long, as an advance seems the natural thing if demand should take on any further pronounced increase. Sentiment is of the sanguine order regarding the outlook, and if there is no contraction in exports higher prices may be reckoned among the probabilities."

THE SHIP TRUST BUILDING.—About nine out of ten of the Americans abroad will wend their way, sooner or later, to the new Cockspur Building, just opened in London, which contains the offices of all the lines combined in the International Mercantile Marine Company, better known as the "Ship Trust." Heretofore the steamship offices in London were scattered broadcast. Now they are concentrated in the Cockspur Building, located in a place easy of access, a block or two from Trafalgar Square. Any one can find Trafalgar Square, and, therefore, any one can find the place where he must go to fix up his steamship tickets and arrange other details of his trip abroad. This new Mecca for the American tourist in London is American all the way through. It was put up by American builders with American materials, and is classed among the best examples of the modern types of architecture springing up in the midst of old London. The speed with which the building was run up was the marvel of the day, and its completion a few weeks ago was made the occasion for a good many hard "knocks" about the deliberate methods of British builders. The building is a steel-frame structure, the hollow-tile fireproofing material for which was imported from Perth Amboy, N. J. As one of the first fireproof buildings erected in London on an American model it is attracting a good deal of attention, and partly as a result of this and partly because American fireproofing has lately passed severe tests at the hands of the British Fire Prevention Committee, American steel-frame, fireproof construction is sharing largely in the building boom now in progress in London. The work on the building is due chiefly to the new company in which Mr. J. G. White is interested, and which is building also the new Hotel Ritz in London.

EEL RIVER PLANT.—The Eel River Power & Irrigation Company has closed contracts for the equipment of its electric power transmission plant, which is to be constructed in the Potter Valley, about 20 miles northeast of Ukiah, Cal. The Westinghouse Electric & Manufacturing Company secured the order for two 2,000-kw, 3-phase, 60-cycle generators and the transformers necessary for the 50,000-volt transmission line. Girard water wheels have been ordered and will utilize a head of 440 feet of water. A dam, 90 feet high, in the Eel River, will add about 60 feet to the working head. Additional dams will be constructed in time to provide for storage. The poles are being set for the main transmission line to Ukiah, where the company has secured a contract for city lighting. A line will be run to Willits. Electric light and power will be furnished for a number of towns and several projected electric railways. Transmission to San Francisco Bay points is among the possibilities. The power plant site is on the bank of the Potter Valley branch of Eel River. The discharge water will be conducted from the wheels by a ditch one mile in length and a tunnel into the Russian River. It is said that it is feasible to store fifty billions of gallons of water for power purposes by the erection of a dam at one of the proposed storage locations.

TELPHERAGE IN GAS WORKS.—The United Telpherage Department of the Dodge Coal Storage Company, Philadelphia, calls attention to the utility of the telpherage system in gas manufacture. In one telpherage installation at the works of the Worcester Gas Light Company, Worcester, Mass., the electric telpher picks up a load of coke upon its discharge from the ovens, conveys it, quenched, some 700 feet to a crushing and screening plant, and discharges it into the hopper of the crusher, from which it is delivered to screens of different sizes of mesh. These screens automatically sort and distribute the coke to the various bins, and at the same time separate the breeze. From the bins the coke is drawn directly into wagons for delivery to purchasers.

APPARATUS WANTED.—The Standard Electric Light, Heat & Power Company, of Avoca, Pa., is in the market for a direct-connected, two-phase unit, 60 cycles, 2,200 volts, 200-kw and a corresponding four-valve type of engine. It is also in need of a belted machine and engine, same size, frequency and voltage; also belting, steam piping, separator, switchboard, etc. Mr. Frank Howard is superintendent and Mr. J. B. Russell, treasurer.

NEW HART & HEGEMAN FACTORY.—The Hart & Hegeman Manufacturing Company, which makes electric switches, has commenced work on its new factory at the northwest corner of Capitol Avenue and Broad Street, Hartford, Conn. The building will be 60x190, three stories high, and be built of red-faced brick, fireproof, with concrete, and have steel concrete floors.

THE RYAN CONSTRUCTION COMPANY, of Indianapolis, Ind., has just completed for George S. Cook, of Hope, Ind., a direct current, 220 volts, electric light plant, of 75 kilowatts capacity, for furnishing current for street lighting and commercial purposes.

THE WESTERN WHEELED SCRAPER COMPANY, Aurora, Ill., has completed a large addition in which it has installed a 15-ton, 3-motor, electric traveling crane made by the Northern Engineering Works, of Detroit.

ELECTRIC STORAGE BATTERY.—Advices from Philadelphia state that the Electric Storage Battery Company has recently received important orders both from home and foreign fields and its volume of business at the present time is greater than ever before. Large contracts have been obtained from the New York Edison Company, Kansas City Light & Power, Chicago Edison, one of the Chicago elevated railroads and from Mexico and South American countries. Quite a large installation will be sent to Sao Paulo, Brazil, to be used in connection with a water power plant. In consequence of this great activity in both local and foreign trade the volume of business exceeds all previous records and for the first six months of the present year was actually larger than for the entire year 1904. Not only was this the fact, but the six months' business was greater than that of any full year, with one exception, in the company's history. With the large contracts recently entered into and the orders already on the books continued activity during the remainder of the year is assured and 1905 will far surpass what had heretofore been the banner year in the amount of work performed and of profit arising therefrom. Contracts for supply of batteries to Canada and other British colonies, as well as to Mexico and South America, are filled at the company's plant at Manchester, England, where wages are lower than in this country, and where advantage can be taken of the lower tariffs on goods shipped to those countries from England than on imports from the United States.

SUBMARINE BOATS.—John P. Holland, inventor of submarine torpedo boats, has filed in the Court of Chancery at Newark, N. J., his formal answer to the suit brought against him by the Electric Boat Company, with which he was associated for the five years from 1899 to 1904. The answer is filed by Vreeland, King, Wilson & Lindabury, and contains besides the answer of the defendant inventor his cross bill to the complainant's allegations, in which he prays that all patents assigned by him to the Electric Boat Company be declared to be improperly held, and that the court order that corporation to reassign the same to him because of its failure to fulfill the specifications and terms of the contract under which they were assigned. He also asks that the complainant company be directed to reassign for the same reason all foreign patents granted to him and by him assigned to the company. The answer and cross bill contain allegations as to the causes leading to the want of success on the part of the company organized to exploit Holland's submarine boats. They assert that after securing the assignments from Holland of fifteen patents covering inventions for controlling the operation of the submarine boat and its armament, he was forced to the background and his advice and experience as a practical submarine engineer were ignored, and the management and construction of the vessels were placed in charge of engineers who, he avers, had no knowledge whatever of submarine construction or requirements.

SUBMARINE SIGNALS.—The Submarine Signal Company, of Boston, has received an order from the lighthouse board of Great Britain for the installation of its system on the North Goodwin Shoals lightship and the government lighthouse tender. The company is also in negotiation with the engineer and commissioner of Irish lights at Dublin for a complete outfit there. The company has also received its first order for apparatus from the French Government, the order being placed by the chief engineer of navigation at Cherbourg. The company has just completed an electric shore station at Point Allerton, with a cable running 2½ miles out to mid-channel at the main entrance to Boston harbor, and put in a submerged bell on a tripod 60 feet below the surface at low tide. The *Kronprinz Wilhelm* is to be equipped with signaling apparatus.

ELECTRICAL SAFEGUARDS FOR BATTLESHIPS.—Contracts have been let to the Long Arm System Company, of Cleveland, O., for installing its electrically operated bulkhead doors and hatch gears on the battleships *Montana* and *South Carolina*. The two vessels are now in course of construction by the Newport News Shipbuilding & Dry Dock Company. The Navy Department specifications for these warships provided that "each (power) door must be capable of permitting operation on the spot by power or by hand from either side, and all such doors are to be capable of being closed by power simultaneously from an emergency station." These conditions were met by the Long Arm System.

Financial Intelligence.

THE WEEK IN WALL STREET.—Seasonable dullness prevailed in the stock market, but there was a strong tone despite the professional character of trading, the leading factors of the week, such as the placing of Union Pacific and Amalgamated Copper stocks on a 5 per cent dividend basis, producing a favorable effect upon sentiment. United States Steel stocks were inclined to respond to favorable steel trade news. The United States Rubber shares were prominent on stories of speedy dividends on the common. Quietness prevailed in electric and traction securities, the fluctuations being within narrow limits. Allis-Chalmers common closed at 16, and preferred at 58, the former being a net gain of ¼ point. General Electric is unchanged at 175, and Westinghouse common is down ½ point, closing at 167. Westinghouse preferred closed at 190, which is a net loss of 4 points. Brooklyn Rapid Transit closed at 69⅛, a net loss of ½ point; Metropolitan Street Railway at 126¾, a gain of ½ point, and Interborough Rapid Transit at 204. American Telephone & Telegraph closed at 138⅝, a net loss of ⅞ point, and Western Union made a net gain of ¼ point, closing at 93⅜. The curb market, while not particularly active, had several noteworthy features. The rise in Interborough and in Chicago Subway seemed to be entirely speculative. The advance in United Copper was referable to the payment of a first dividend, and talk about further activity in the copper trade. Following are the closing quotations of July 25:

NEW YORK

	July 18	July 25		July 18	July 25
Allis-Chalmers Co.	16¼	15⅝	Electric Vehicle pfd.	25½	26
Allis-Chalmers Co. pfd.	56	55⅝	General Electric	174½	173½
American Tel. & Cable	90	90	Hudson River Tel.	..	..
American Tel. & Tel.	139	139	Interborough Rap. Tran.	203⅜	205
American Dist. Tel.	29	29	Metropolitan St. Ry.	127¼	125½
Brooklyn Rapid Transit	69⅛	67¾	N. Y. & N. J. Tel.	..	..
Commercial Cable	..	..	Marconi Tel.	..	..
Electric Boat	20	20	Western Union Tel.	93	93¼
Electric Boat pfd.	60	60	Westinghouse com.	167	165½
Electric Lead Reduction	..	..	Westinghouse pfd.	..	..
Electric Vehicle	18	18			

BOSTON

	July 18	July 25		July 18	July 25
American Tel. & Tel.	139	139	Western Tel. & Tel. pfd.	101	*99
Cumberland Telephone	117½	117	Mexican Telephone	1¼	1¼
Edison Elec. Illum.	243	243	New England Telephone	139	*138
General Electric	..	173	Mass. Elec. Ry.	18	18
Western Tel. & Tel.	18	18	Mass. Elec. Ry. pfd.	63	62½

PHILADELPHIA

	July 18	July 25		July 18	July 25
American Railways	51	51	Phila. Traction	99¼	99¾
Elec. Storage Battery	81	82	Phila. Electric	8¾	8⅞
Elec. Storage Battery pfd.	..	..	Phila. Rapid Trans.	27⅛	27¼
Elec. Co. of America	11¾	11⅛			

CHICAGO

	July 18	July 25		July 18	July 25
Central Union Tel.	..	..	National Carbon pfd.	117½	117½
Chicago Edison	..	158	Metropolitan Elev. com.	23¾	23¾
Chicago City Ry.	..	..	Union Traction	..	..
Chicago Tel. Co.	..	..	Union Traction pfd.	..	..
National Carbon	63½	63			

* Asked.

DIVIDENDS.—The Chicago Edison Company has declared the regular quarterly dividend of 2 per cent, payable August 1. The $36,000,000 syndicate which took over the Chicago City Railway Company January 1 at $200 per share, paid a dividend on July 1 of 4½ per cent. The American Light & Traction directors have declared the regular quarterly dividend of 1½ per cent on the preferred stock and a quarterly dividend of 1 per cent on the common stock, both payable August 1. The International Steam Pump directors have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable August 1. The Twin City Rapid Transit Company directors have declared the regular quarterly dividend of 1¼ per cent on the common stock, payable August 15. The Montreal Light, Heat & Power Company has declared a quarterly dividend of 1 per cent, payable August 15. The directors of the Butte Electric & Power Company have declared the regular quarterly dividend of $1.25 on the preferred stock, payable August 1. The Boston Elevated Railroad Company has declared a semi-annual dividend of 3 per cent, payable August 5. The Western Telephone & Telegraph Company has declared a semi-annual dividend of 2½ per cent on preferred stock, payable August 1. Directors of the Automatic Electric Company have declared the regular quarterly dividend of 2 per cent, payable August 1. The National Telephone Company, of Fort Wayne, has declared the regular quarterly dividend of 1 per cent. The National Carbon Company has declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable August 15.

TELEPHONY IN PHILADELPHIA.—It is reported from Philadelphia that the telephone business in that city and surrounding territory is being pushed as never before, resulting in a rapid extension of the service on all sides. The Bell Telephone Company, of Philadelphia, in its own operations and those of its controlled companies outside of Philadelphia, is stated to be expending $1,700,000 on extension of its local lines. The capital was lately increased $2,000,000 by an issue of stock; half a dozen companies in the Maryland, Delaware and southern territory were recently acquired by purchase of their stock, and the number of telephones installed by the Philadelphia company and the Delaware & Atlantic will reach 100,000 in a few days. The Keystone Telephone Company, of Philadelphia, is about to spend $750,000 more on its plant, which will then represent a cash investment of about $6,000,000, and the number of telephones installed by this company, now 17,000, is being steadily increased.

ELECTRIC BOND & SHARE COMPANY.—Harvey Fisk & Sons say of the formation of the Electric Bond & Share Company, the $4,000,000 holding company for electric securities organized in the interests of General Electric: "The Electric Bond & Share Company is organized under New York laws, with power to purchase bonds, stock or other forms of securities resulting from electric developments, such as electric street railways and electric light and power plants. The corporation has issued $2,000,000 preferred and $2,000,000 common stock. It begins business with capital stock fully paid up and with a surplus estimated by its officers, after careful appraisal by a special committee appointed for the purpose, to be of the value of $440,000. All of the common stock is owned by the General Electric Company. The preferred stock has a 5 per cent cumulative preference as to dividends, is also preferred in any distribution of assets, and is further protected by a provision that no dividends shall be paid upon the common stock unless there shall remain, after such dividends, a surplus equal to at least 15 per cent of the par value of the then outstanding preferred stock. The preferred stock can never be increased to such an amount as to exceed the amount of the then outstanding common stock, and may be retired upon any dividend date, upon 90 days' notice, at 110. The corporation is forbidden to mortgage, pledge or in any way hypothecate any of its assets without the assent of three-fourths of the preferred stock, or, save by nine-tenths vote of all stock outstanding, to buy or contract to buy any securities unless the corporation at the time of making such contracts has cash in bank sufficient to pay for such securities."

OPERATIONS OF BOSTON EDISON.—The past year's operations of the Boston Edison Company include practically a year's supply to the city of Chelsea, the Edison Company securing this new field of operation through the joint purchase with Massachusetts Gas interests of the Chelsea Gas Light Company, which company not only controlled the gas but also the electric business in the city of Chelsea. It is the present intention of the Edison Company to extend its field of operations this fall and supply the city of Newton and the town of Watertown. At the present time the Newton & Watertown Gas Company supplies these two localities with both gas and electricity, but by reason of its ownership being vested with Edison Company-Massachusetts Gas interests the plant will be dismantled and the electric business will be taken over by the Edison Company and the gas business by the Boston Consolidated Gas Company. The Edison Company has already built a substation in Newton on Commonwealth Avenue, for use in supplying the Newton and Watertown fields, and is now connecting its Boston lines with the electric system of the Newton & Watertown Gas Company. It is possible that the Chelsea Gas Light Company and the Newton & Watertown Gas Light Company will be formally taken over by the Boston Consolidated Gas Company this fall. These companies when taken over will be strictly gas companies, the electric departments of both companies having been sold to the Edison Company.

MILWAUKEE ELECTRIC EARNINGS.—The Milwaukee Electric Light & Railway Company, one of the companies controlled by the North American Company, has reported earnings for June and for the six months ended June 30. The June earnings showed an increase of 5.3 per cent in gross, an increase of 7 per cent in net and an increase of 9 per cent in surplus as compared with the corresponding month in 1904. For the six months ended June 30 gross increased ¾ per cent, net increased 4.1 per cent and surplus increased 8 per cent compared with the same period in 1904. The surplus after charges for the six months, amounting to $318,506, is at the rate of about 5 per cent on the $8,135,000 of common stock, practically all of which is owned by the North American Company and is one of its most valuable assets. Dividends at the rate of 5 per cent yearly are now being paid on the common stock. A considerable amount of the company's earnings are being put back into the property.

B. R. T. BONDS.—To provide for extensions and improvements, the management of the Brooklyn Rapid Transit Company has just sold an additional $2,500,000 of its 4 per cent convertible bonds at 86, as against the present market price of 89. The total amount of these bonds outstanding now amounts to $19,500,000. The increase in earnings on the Brooklyn system is a surprise to the management. This year 200 additional cars have had considerable influence upon earnings. For the first seventeen days of July, gross earnings of the Brooklyn Rapid Transit increased $8,770 per day, or an increase of $149,000 for seventeen days, which would indicate a gross increase for July of between $200,000 and $250,000, a phenomenal record. For the year ended June 30, 1905, the Brooklyn Rapid Transit earned $16,000,000 gross. The stock and bonds of the system have naturally been strong on such a showing.

ELECTRIC CRANE CONSOLIDATION.—The Shaw Electric Crane Company, of Muskegon, Mich., has been merged with the Ashcroft Manufacturing Company and the Consolidated Safety Valve Company, of Bridgeport, Conn., and the Hayden & Derby Manufacturing Company, the Hancock Inspirator Company and the United States Injector Company, of Boston, Mass., all of which are controlled by Manning, Maxwell & Moore, of New York City. The new corporation was formed under the laws of New Jersey with a capital of $5,000,000. The board of directors numbers 15 members, John G. Emery, of Muskegon, being one of the directors. The Shaw Electric Crane Company will retain its corporate existence, and no change will be made in the affairs of the company due to the merger.

PHILADELPHIA KEYSTONE TELEPHONE.—A Keystone Telephone interest in Philadelphia says: "The financing of the company is complete by the recent sale of the $4,000,000 5 per cent bonds. The original intention to retire the present stock by exchange for bonds was abandoned. The sale of the bonds clears up all the indebtedness of the company, takes care of all construction not previously paid for, and leaves $600,000 cash for immediate construction. Additional bonds are issuable in the future at a rate not exceeding $600,000 per annum, for future extension. It is estimated that the present basis of earnings is equal to twice the amount of the interest on the $4,000,000 5s. It is understood that the bankers, Fish & Robinson, have until July 17th to pay for the issue, though the sale is an absolute one."

MAIL TUBE A FAILURE.—The Central Trust Company of New York has brought suit in the Supreme Court against the Tubular Dispatch Company to foreclose a mortgage of $600,000 made on July 1, 1897, as security for bonds of the same amount. The mortgage includes franchises, rights, pneumatic plant, property, etc., and two double circuits of pneumatic tubes for the carrying of mail matter. Circuit 1 of the tube system consists of a double line of tubes from the main postoffice to the sub-postoffice in the Produce Exchange Building; Circuit 2 consists of a double line of tubes from the main postoffice to Postal Station H, on Lexington Avenue. The proper way to do this thing is by electricity.

CUYAHOGA TELEPHONE COMPANY.—F. S. Dickson, president of the Cuyahoga Telephone Company, is authority for the statement that the directors of that company have considered the advisability of putting the common stock on a dividend basis the first of next year. He says that at the present rate of earnings the company will be in position to pay 4 per cent on its stock at that time without detriment to its capacity. It is not assured that the company will be able to pay the full 4 per cent, however, but that the stock will get some dividend January 1 seems to be quite certain.

OMAHA ELECTRIC BONDS.—N. W. Harris & Co. are offering $1,200,000 Omaha Electric Light & Power Company first mortgage 5 per cent bonds, due July 1, 1933, but optional, at 105 and interest on and after July 1, 1908. This company owns or controls practically the entire electric light and power business in Omaha, South Omaha and Council Bluffs, the combined population of the cities being at present more than 170,000. The company and its predecessor have paid annual dividends of 5 per cent on the preferred stock for the past fifteen years.

DETROIT UNITED RAILWAY.—The Detroit United Railway has completed the first half of its fiscal year. June earnings which have just been reported showed an increase of 11 per cent in gross earnings and 12.7 per cent in net earnings. For the half year the surplus earnings after charges amounted to $358,030, applicable to dividends. The stock outstanding amounts to $12,000,000, so that the earnings for the half year have been at the rate of approximately 6 per cent on the stock.

CONNECTICUT RAILWAY & LIGHTING.—The first and refunding mortgage 4½ per cent gold bonds of the Connecticut Railway & Lighting Company have just been declared a legal investment for savings banks in the State of Connecticut. This issue was originally brought out by Messrs. Redmond & Co. and J. & W. Seligman & Co. A recent statement of the company's gross earnings shows an increase of 11 per cent over the same period of 1904 and 64 per cent over 1903.

PHILADELPHIA TROLLEY EARNINGS.—The total gross income of the Philadelphia Rapid Transit Company for the fiscal year was about $16,400,000, an increase of $470,000 over last year. The traffic income was $16,200,000 and other income was $200,000. Gross earnings during June increased $95,000 over June of last year.

HUDSON RIVER POWER.—The Hudson River Electric Power Company reports as follows: May gross, $50,865; increase, $15,351; May, net, $21,600; increase, $5,246; five months' gross, $259,570; increase, $72,899; five months' net, $100,755; increase, $23,060.

ATLANTIC TELEPHONE.—Articles incorporating the Atlantic Telephone Company have been filed in the Kings County Clerk's office, Brooklyn, N. Y. The capital is $5,000,000.

General News of the Week

The Telephone.

MOBILE, ALA.—The Home Telephone Company has increased its capital stock to $350,000. Two hundred thousand dollars will be used in improving the system at once.

SLIPPERY ROCK, ILL.—The Slippery Rock Telephone Company has been incorporated with $5,000 capital.

TAYLORVILLE, ILL.—A meeting of the independent telephone companies of Christian County has been held, and it was decided to merge all the companies into one. The merger includes exchanges at this city, Morrisonville, Stonington and Edinburg.

LINCOLN, ILL.—The property of the Farm & City Telephone Company, extending through the six counties of De Witt, Piatt, Champaign, McLean, Logan and Macon, was sold to B. F. Wasson, of Clinton, and Samuel Martin, of Waynesville, for $44,186.60, on July 20. They transferred the property immediately to the National Telephone & Electric Company for a consideration of $100,000.

LAFAYETTE, IND.—The Central Union Telephone Company has begun the work of placing its wires underground.

ROSEDALE, IND.—The Rosedale & Fontenac Farmers' Telephone Company, of Parke and Vigo counties, has filed articles of incorporation. The capital stock is $3,000. Thos. M. Patterson, Wm. Stuthard, George Rukes and Chas. Mulvahill are the directors.

CANNELTON, IND.—The City Council has granted a franchise to the Eckert, Branchville & Cannelton Cooperative Telephone Company, a farmers' co-operative concern, with lines running through Dubois and Perry counties and seeking an outlet to the Ohio River.

ROCKVILLE, IND.—The Parke County Telephone Company is establishing a new exchange and its general offices in the Union Block. The new quarters are complete in every particular and the latest and best equipment is being installed. The Parke County Telephone Company was incorporated in 1899, with $12,000 capital stock, which has since been increased to $36,000. The company is now operating over 400 miles of wire and 200 miles of poles, which includes 125 miles of toll lines. The cost of the present improvement will be over $4,000.

ALVORD, IA.—The Cleveland Township Telephone Company has been formed, with a capital stock of $700, by Frank Donelly, John Langfeld and others.

DUBUQUE, IA.—The Iowa Telephone Company has purchased property on Locust Street for the purpose of erecting a telephone exchange. The company has begun the expenditure of $150,000 in local improvements.

BALTIMORE, MD.—The Maryland Telephone Company proposes to extend its lines. Contracts have already been placed for about $300,000 worth of improvements.

DETROIT, MICH.—At the July meeting of the Board of Directors of the Citizens' Telephone Company the quarterly dividend of 2 per cent was declared.

BAY CITY, MICH.—The Northeastern Telegraph & Telephone Company has installed an exchange in Rose City and another in Lupton, and is now covering rapidly the entire northern and northeastern portions of the State. In Alpena, Ogemaw and other counties, rural telephone extensions are being planned. The lines connect with the Michigan Telephone Company at Bay City.

BROWERVILLE, MINN.—A telephone company has been organized with a capital of $2,000 by Harry Lee, president, and Lambert Irefield, treasurer.

HALLOCK, MINN.—The Hallock Telephone Exchange has extended its line in the southern part of town and added many new telephones.

DEERWOOD, MINN.—A new telephone company, to be known as the Deerwood Bay Lake Telephone Company, has been organized by A N. Gray and David Archibald.

ORAN, MO.—The Scott County Telephone Company of Oran has filed letters of incorporation. The capital stock is $12,000. The incorporators are Frank J. Stein, Arthur V. Scheiber, N. H. Stubblefield, Jr., M. Helmacher and others.

ST. JOSEPH, MO.—The Missouri & Kansas Telephone Company, having refused to comply with the request of the Retail Merchants' Association for a rate of $50 per year, a resolution has been adopted which provides that the use of the "old" telephones shall be discontinued at the expiration of contracts now in effect.

ADAMS, NEB.—The Adams Telephone Company has been formed with a capital of $12,500 by John H. Agee and Herbert H. Herndon.

JERSEY CITY, N. J.—The annual meeting of the American Union Telegraph Company of New Jersey has been held, and the following officers elected for the ensuing year: President R. C. Clowry; vice-president, Thomas F. Clarke; secretary and treasurer, A. R. Brewer; directors, R. C. Clowry, B. Brooks, Thomas F. Clarke, J. B. Van Every and J. B. Bertholf.

JERSEY CITY, N. J.—The New York & New Jersey Telephone Company has notified the Street and Water Board that it will submit to it plans for placing all telephone wires here underground in conduits as far as is practicable.

MIDDLETOWN, N. Y.—A 25-year franchise has been granted to the Middletown Telephone Company.

WEEDSPORT, N. Y.—The Weedsport Telephone Company has been formed. Capital, $20,000. Incorporated by Charles S. Gaywood, N. E. Durston.

ALBANY, N. Y.—The Westport, Essex & Lewis Telephone Company has been organized. Capital, $3,000. The incorporators are Frank E. Smith and Melvin E. Lott.

NAPLES, N. Y.—The Ontario & Steuben Telephone Company, of Naples, Ontario County, has been incorporated; capital, $400,000. Directors: J. E. Lyon, W. H. Housel and F. W. James, Naples.

ALBANY, N. Y.—The Commonwealth Telephone Company, of Brooklyn, has been incorporated; capital, $200,000. The directors are E. M. Brooks, Daniel Bohre, Brooklyn; J. A. Crawford, Montclair, N. J.

DUNDEE, N. Y.—At the annual meeting of the Dundee Telephone & Telegraph Company, officers were elected for one year as follows: President, Charles J. Watson; vice-president, Clayton G. Howell; treasurer, Robert B. Swortz; secretary, Harry B. Harpending; manager, Silas A. Price.

JAMESTOWN, N. Y.—At the meeting of the Home Telephone Company, of Jamestown, Jules Vautrot, of Warren, was reelected president, as were C. C. Clawson, R. T. Izant, C. B. Selby and G. B. DeVoe to the directorate. The company added nearly 400 new telephones last year, and the usual dividend surplus of the year was voted to be used for the extension of the company's business the coming year.

JACOBSBURG, OHIO.—The People's Telephone Company, of Jacobsburg, has increased its capital stock from $2,000 to $4,000.

JACKSON, OHIO.—The Citizens' Telephone Company, of Jackson, has been formed and incorporated by Chester A. Dyer, G. W. Brooks, Joseph Lewis, R. E. Swaney and C. C. McKinniss; the capital is $4,000.

LOWELL, OHIO.—The Lowell Telephone Exchange Company, recently incorporated for $10,000, has let the contract for installing the lines and equipment of the company to the A. T. Brennan Company, of Zanesville.

COLUMBUS, OHIO.—Fire on July 14 damaged the apparatus in the Central Union Telephone Company's building to such an extent that the city's entire telephone service will be suspended for days. The loss to the company is about $25,000.

CORBETT, OKLA.—The Citizens' Telephone Company has been incorporated with a capital stock of $10,000 and the following stockholders: E. M. Abernathy, of Lexington, J. P. Corbett, Wm. Montan, Lee Balew and P. A. Homes of Corbett, and W. E. Dragor, of Buckhead.

BERWINDALE, PA.—The Clearfield & Cambria Telephone Company has been formed. Capital, $5,000.

BELLS RUN, PA.—The Bells Run Telephone Company has been formed to build a telephone line; capital, $6,000. Incorporators: Fred E. Gleason and John J. Robarts, Ceres; LeRoy M. Lanphen, Bells Run, Pa., and others.

BALDWIN, WIS.—The Baldwin Telephone Exchange, of Baldwin, has made an amendment increasing its capital to $15,000.

Electric Light and Power.

DOTHAN, ALA.—It is proposed to improve the water works and electric light plant at a cost of $20,000.

ELBA, ALA.—The Pea River Power Company has been incorporated with a capital of $100,000 by Chas. Henderson, H. D. Boyd, J. M. Garrett and others, to supply Elba with electricity for lighting, heating and power purposes.

FAIRBANK, ALASKA.—The Tanana Electric Company has been incorporated at Olympia, Wash., by Abe Spring, of Fairbank, and J. A. Haney, of Seattle, Wash., with a capital of $250,000, to establish a lighting and steam plant at Clery City, Alaska, which is about 25 miles from Fairbank.

SAN FRANCISCO, CAL.—The Western Power Company, which has extensive water rights in the vicinity of the Big Bend of the Feather River, and in the Big Meadows region, is showing great activity again. During the past two years but little was accomplished, but it is understood that a large sum of money has been appropriated for preliminary engineering work of an exhaustive character. About 60 men have been put to work under the general supervision of Engineer Julius M. Howell, who has been connected with the company for several years. A party of Eastern capitalists, who are now interested in the system originally projected by Los Angeles people, have been visiting the proposed power sites. Some intricate engineering problems are involved, which it is proposed to thoroughly investigate before completing the details of the plans. The original purpose was to transmit power direct to San Francisco, a distance of 160 miles, or more. Among the other possible markets for power are mining work, electric railways and main line railroads. The company has enormous quantities of valuable timber on its lands. Dr. Thomas Addison, manager of the General Electric Company's San Francisco district agency, is a stockholder.

NORWICH, CONN.—The municipal electric light plant reports a profit for the year of $10,545. A new unit is needed, also a new smokestack and an addition to the coal shed, which, with other repairs and additions, involve the sum of $48,000.

JACKSONVILLE, FLA.—Bids will be received until August 4 by the Board of Trustees of the Water Works and Improvement Bonds, for furnishing f. o. b. cars, Jacksonville, a motor-generator set of about 300-kilowatt capacity, the generator to be a 550-volt, direct-current, compound-wound machine, driven by a direct-connected, 3-phase, 60-cycle, 2,300-volt synchronous

motor, large enough to drive the direct-current generator at its rated capacity; machine to be arranged so as to be reversed; and an alternate bid for the same generator driven by a 3-phase, 60-cycle, 2,300-volt induction motor, direct-connected, of sufficient size to drive the generator at its rated capacity, the speed of the machine not to exceed 750 r.p.m. Field rheostats for the direct-current machine and starting device for the alternating-current machine to be furnished. R. N. Ellis is superintendent.

CAMILLA, GA.—An election will soon be held to vote on issuing $6,000 bonds for improving the electric light plant.

FORT GAINES, GA.—The City Council has granted the Interstate Water Works & Construction Company, of Washington, D. C., a 50-year franchise for the construction of water works and an electric light plant.

BELLEVILLE, ILL.—The Retail Merchants' Association has decided to organize a company for the construction of another gas and electric plant in Belleville. A charter will be obtained in a few days and franchises asked for.

POSEYVILLE, IND.—The Poseyville Electric Light & Water Company has been incorporated, with a capital of $10,000.

CRAWFORDSVILLE, IND.—The Crawfordsville Water & Light Company has secured a new franchise and will at once make extensive improvements and purchase new machinery.

MUNCIE, IND.—After owning and operating its electric light plant for twelve years this city is about to contract with a private company for electric street lighting at 3½ cents per kilowatt-hour.

PERU, IND.—This city has in contemplation the reconstruction of its electric light plant, and would like to have some one complete the project, both financially and mechanically. Wm. O'Hara is the city clerk.

CRAWFORDSVILLE, IND.—The report of the municipal electric light and power plant for June shows total receipts to be $5,191.76, and the expenses $5,690.76. A street and alley account of $1,064 was paid during the month, otherwise the plant would have been self-sustaining.

INDIANAPOLIS, IND.—The plant, equipment and assets of the Home Heating & Lighting Company have been turned back to the officers of the company after being in the hands of a receiver for a year. All claims have been paid, a new franchise granted permitting an increase in the rates and it is now believed the plant will be operated profitably.

PITTSBURG, KAN.—The contract for furnishing electric machinery and apparatus for the new light and power station of the Home Light, Heat & Power Company, has been awarded to the Westinghouse Machine Company, of Pittsburg, Pa.

RUSSELL, KY.—E. E. Fullerton and H. Willis, of Greenup, are interested in the construction of an electric light plant in Russell.

BANGOR, ME.—Wallace C. Johnson, of Niagara Falls, N. Y., is engineer for the proposed power plant of the Bodwell Water Power Company. No contracts have been awarded as yet.

WATERVILLE, ME.—The Messalonskee Electric Company has been organized under special charter at Waterville, with a capital stock of $250,000, of which $186,500 is paid in. The officers are as follows: President, Harvey D. Eaton; vice-president, John N. Webber; treasurer, William T. Haines; clerk and assistant treasurer, Edward L. Meader; general manager, Walter S. Wyman. The new corporation takes over the present property, franchises and going business in Oakland of the Oakland Electric Company, which was incorporated under the general law, and also the property, franchises and business in Waterville hitherto owned by Messrs. Eaton and Wyman as a partnership.

BRUNSWICK, MD.—G. R. Bready, general manager Harpers Ferry Electric Light & Power Company, Harpers Ferry, W. Va., writes in regard to work contemplated at Brunswick, that about $12,000 will be expended, but contracts have all been closed with the exception of that for a 95-kw. alternator.

LEICESTER, MASS.—At the annual meeting of the Rawson Light & Power Company, in Leicester, the present officers were reelected.

SOUTHBRIDGE, MASS.—The annual meeting of the stockholders of the Southbridge Gas & Electric Light Company has been held. The following officers were chosen: Clerk, Albert D. Wells; treasurer, George N. Corey; auditors, John M. Cockran and Fred. E. Coburn.

LEOMINSTER, MASS.—The Leominster Electric Light & Power Company has secured the contract for lighting the city for the coming year at the following bid: 92 arc lights at $72 per year, each to burn until 1 a. m.; 20 arc lights to burn all night at $110 per year each, and 72 incandescents at $10 each; total cost, $9,976 per year.

TURNERS FALLS, MASS.—The annual meeting of the Turners Falls company has been held. These officers were chosen: President, Charles T. Crocker, of Fitchburg; clerk and treasurer, Charles W. Hazelton; directors, C. T. Crocker, Jonathan Bulkley of New York, Charles E. Stevens of Ware, Alvah Crocker of Fitchburg, W. P. Dustin, D. P. Abercrombie, C. W. Hazelton. The office of vice-president was created and W. P. Dustin elected to the position. The company has recently finished an extension of the canal, and last year widened the upper end. A new power house has been built the past winter, and is now being equipped with machinery for generating electricity. When the power house is fully equipped the company will have expended probably $450,000.

MANCELONA, MICH.—James R. Jenkins and Dr. J. W. Verdier have applied to the City Council for an electric lighting and power franchise. They propose to secure power from Cedar River.

GRAND HAVEN, MICH.—Contracts have been let for increasing the power of the city lighting plant. The Ball Engine Company will furnish the new engine and the Fort Wayne Electric Works the generator.

MANCELONA, MICH.—Fire destroyed the Mancelona lighting plant, entailing a loss of $3,000. The plant was owned by Fred Wilde, of Escanaba, who will at once rebuild, as his contract with the city continues for four years.

KALKASKA, MICH.—The Kalkaska Light & Power Company has submitted a proposition to the village to furnish power for operating 500,000-gallon pumps for the city water works.

ESCANABA, MICH.—There was an overdraft against the municipal lighting plant of $9,995.95 on July 1. On May 1 the overdraft was $9,611.40. Collections in June amounted to $8,414.63. The equipment of the plant is in poor condition and should an accident occur the service would be seriously crippled.

CLARE, MICH.—Negotiations looking to the city's acquisition of the electric light plant on a basis of 80 per cent. of the appraised valuation have been declared off, because the company, having entered into a contract for pumps, refused to release the city short of the full value of the pumps, $2,000.

GRAND RAPIDS, MICH.—The Michigan Trust Company of this city, which operates the electric light and power plants at Cadillac for Wellington W. Cummer, is seeking to incorporate the two companies under the State law that bonds may be issued to secure the costs of improvements and extensions.

PONTIAC, MICH.—The Clinton River Power Company has been incorporated with a capital stock of $75,000, of which $50,000 is common stock and $25,000 preferred stock. The franchise which the company will work under was granted to Fred J. Seeley for commercial lighting in Pontiac. Power for generating the current will be furnished by the Clinton River, which, according to the reports of the engineers, will produce 1,500 horse-power between Pontiac and Amy. The power will be supplied to Pontiac and the surrounding villages and resorts. The contract for the engineering and construction work has been awarded to MacKeen, Ball & Co., of Chicago. The equipment will include twin wheel, 25-inch, horizontal, steel-cased turbines, each of 200-hp. capacity at a 28-foot head of water. Two 200-hp. generators will be coupled direct to the turbine shaft.

AUSTIN, MINN.—The Electric Light, Power & Water Commission will expend about $20,000 for improvements at the electric light plant.

MINNEAPOLIS, MINN.—The Minnesota Power & Trolley Company, Minneapolis, Minn., is having preliminary plans prepared by F. W. Cappelen, Globe Building, for a power house and a 30-foot dam across the Mississippi River at Otsego, Minn.

OMAHA, NEB.—The Omaha Electric Light & Power Company controls the electric light and power business in the cities of Omaha and South Omaha, Neb., and by stock ownership controls the entire gas, electric light and power business of Council Bluffs, Ia. The company owns an electric power station capable of generating 5,000 horse-power, and has contracts with the city of Omaha and South Omaha to provide street lights until 1908 and 1909 respectively. The company showed net earnings for the year ended May 31, 1905, of $124,667, and a surplus of $50,688. The item of operating expenses includes an arbitrary charge of $40,000 per year against depreciation. Gross receipts for the last fiscal year increased 13 per cent. over the 12 months preceding. The company has a capital stock of $2,489,3000, and an authorized issue of $3,000,000 bonds, of which $1,580,000 are outstanding.

SPRING VALLEY, N. Y.—The question of constructing an electric light plant at a cost of $25,000 is under consideration.

NEW YORK, N. Y.—The Board of Estimate has approved the report of Nelson P. Lewis, chief engineer of the Board of Estimate, on the proposed municipal electric light plant and authorized him to prepare specifications for a contract for submission to the Corporation Counsel. The probable cost of the plant is $7,500,000. The contract for construction will probably be let in the fall.

OGDENSBURG, N. Y.—The Ogdensburg Power & Light Company has entered into a contract with the Hannawa Falls Water Power Company to furnish Ogdensburg with electric power. The plant of the Hannawa Falls Water Power Company is located on the Racquette River at Hannawa Falls, St. Lawrence County, four and one-half miles south of the village of Potsdam. Its present development gives it a minimum of 10,000 horse-power. It has 20,000 horse-power yet undeveloped a short distance above its plant. To take the Hannawa power to Ogdensburg necessitates the construction of a transmission line about 38 miles long and the expenditure of about $150,000. Aluminum wire will be used and three wires will be strung at first, on cedar poles set 100 feet apart. The receiving station at the Ogdensburg end of the line will be the present power plant of the Ogdensburg Power & Light Company. Rotary converters will be installed for the Ogdensburg street railway. The alternating current will be used to light the streets of the city.

SOUTH BROOKLYN, OHIO.—The municipal lighting plant shows about $3,000 to the bad. The appropriation is $6,000 against $3,000 income. In fact, the deficit, it is said, may run to a total of $7,500 for the year.

TOLEDO, OHIO.—The City Solicitor having decided that the city cannot charge either the East Side Heating & Lighting Company or the Central Heating & Lighting Company for franchises to operate in Toledo, these two concerns have renewed their application for these rights.

NEWARK, OHIO.—The Capital Savings & Trust Company has been appointed fiscal agent of the newly organized Licking County Light & Power Company, of Newark, incorporated by Melville Gillett, Henry G. Bohl, John P. Maynard, W. G. Barthalow and J. W. Darford. The corporation has $200,000 common, $100,000 6 per cent accumulative preferred stock and an issue of 5 per cent 20-year bonds.

PHILADELPHIA, PA.—The Chester County Light & Fuel Company has been formed with $5,000 capital.

WILKESBARRE, PA.—The electric power plant of the Delaware & Hudson Coal Company, in this vicinity, is being enlarged, and within the next few weeks this company will operate and illuminate all its colleries in the northern part of this city by electricity.

YORK, PA.—The Delta Electric Light Company, located along Muddy Creek in the southern part of York County, has been purchased by the York Furnace, Piqua & Lancaster Trolley Company. The purchase has doubtless been made with a view of furnishing power for the proposed new trolley extension into York County. It is said that later the plant will be enlarged, new machinery will be installed and so improved as to increase its power tenfold.

PITTSBURG, PA.—H. P. Dilworth, of the Dilworth Coal Company, and Chas. Arbuckle Jamison, of Arbuckle & Co., and Stewart Robinson, have secured from the Secretary of War the right to use water flowing over Springdale dam in the Allegheny River for power purposes. It is reported that a $400,000 plant will be constructed and power will be furnished for the traction roads in Allegheny Valley and power and light lines will be extended to Tarentum, New Kensington, Oakmont, Creighton, Natrona and Parnassus.

YORK, PA.—John E. Graybill & Co., electricians, of this city, have been awarded contracts to equip the new Harford County Court House, at Belaire, Md., with complete lighting and electric fire signal system; to install in the new technical high school at Harrisburg a direct-connected generating unit to furnish power for electric motors in various parts of the building; storage batteries, electrical instruments, call bells, signals, etc.; also electrical appliances for the new annex to the Harrisburg hospital. The firm will need all kinds of electrical aparatus and material.

SPARTANBURG, S. C.—The Electric Manufacturing Company proposes developing water power at Nesbitt Shoals, at a cost of about $250,000, but nothing definite has yet been done.

CLARKSVILLE, TENN.—The Consumers' Electric Light, Heating & Power Company has petitioned for a franchise.

CHATTANOOGA, TENN.—W. B. Spencer, 16 Exchange Place, New York, N. Y., assistant engineer of the Chattanooga-Tennessee Power Company, states that bids for the construction of the plant, which will cost about $1,500,000, will be received in about four weeks.

JEFFERSON, TEX.—The Jefferson City Light & Power plant, including the ice plant, was destroyed by fire July 5.

EPHRAIM, UTAH.—Bonds to the amount of $15,000 have been sold for the construction of an electric light plant.

PROVO, UTAH.—The citizens have voted to issue $91,000 bonds to be used for the completion of the water works and the construction of a municipal electric light plant.

MONTPELIER, VT.—The Consolidated Lighting Company is to increase the size of its plant at Montpelier and will install a 1,000-hp. steam turbine and generator.

WALLA WALLA, WASH.—An ordinance has been introduced in Council granting C. M. Maxwell and H. Day Hanford of Seattle a franchise to construct and maintain an electric light and gas plant in Walla Walla. It is proposed to organize a company to be known as the Walla Walla Gas & Electric Company.

TACOMA, WASH.—The City Council has authorized the City Clerk to procure bids for the construction of a steam-power electric generating plant, to be established, if possible, within the city limits. The specifications call for a generating plant of at least 5,000 horse-power and not more than 10,000 horse-power. The idea is to secure bids on all kinds of plants for generating electric energy.

LARAMIE, WYO.—The City Council has granted Alfred E. Kalter, of Indianapolis, a franchise for an electric light plant.

NAPANEE, ONT.—The proposed electric light plant will cost about $35,000. No engineer has been selected as yet. W. A. Grange is the town clerk.

OTTAWA, ONT.—The Dominion Government has appropriated $40,000 for electric lighting and power plant on the Welland. This amount is in addition to $100,000 already voted and is rendered necessary by a change of plans. The Government obtains power from the Cataract Power Company, of Hamilton, Ont., and pays $14 per horse-power for the same up to 500 horse-power.

TORONTO, ONT.—A hydro-electric power commission has been appointed by the Ontario Government to inquire into the whole question of electrical production and development in the Province of Ontario. Adam Beck, of London, is chairman, and Cecil B. Smith, chief engineer. R. A. Ross, of Montreal, and his staff of engineers on the municipal power commission are completing the field work in connection with the development of Niagara power, and the cost of transmitting it to Guelph, Hamilton, St. Catherines, Galt, Brantford, London and other western Ontario towns and cities.

CHARLOTTETOWN, P. E. I.—At the City Council meeting the Charlottetown Light & Power Company made the following offer to the city: At the expiration of the present contract, to sell the real estate and plant for $80,000, or if the city renew the present contract to furnish the new street lamps at $75 per light per annum; to reduce the cost of commercial lighting to 12 cents per kilowatt hour and guarantee not to raise this rate; to do away with minimum rate.

MONTREAL, QUE.—According to an official statement the Montreal Light, Heat & Power Company has decided to have all its stations rendered absolutely fireproof. When this work is completed the company will not carry any insurance on its buildings. A saving of $10,000 a year will thus be effected.

The Electric Railway.

PYATT, ARIZ.—The Mineral Belt Traction Company, of this city and Chicago, Ill., has been formed to build a line between Pyatt, Dodd City, Kingdom Springs and Lead Hill. Capital, $200,000. Incorporated by A. J. Bradford and Robert Somerville.

LITTLE ROCK, ARK.—The Mineral Belt Traction Company, of Pyatt, Ark., and Chicago, Ill., has been granted a charter to build a line between Pyatt, Dodd City, Kingdon Springs and Lead Hill. The capital stock is $200,000. The incorporators are A. J. Bradford, Robert Somerville, E. W. Swarz and Neal Dodd.

HOOPESTON, ILL.—The Interstate Traction Company, Hoopeston, Ill., has been organized to build an electric road from Danville, Ill., to Hoopeston and a large power house at Hoopeston. J. H. Dyer is general attorney for the road.

FORT WAYNE, IND.—The L. E. Myers Company, of Chicago, has been awarded the contract for a 23-mile line between Fort Wayne and Bluffton, for the Fort Wayne, Bluffton & Marshall Traction Company.

INDIANAPOLIS, IND.—The North Central Railway Company has filed articles of incorporation with the Secretary of State. The capital stock is $500,000. The promoters, it is said, will build a line into Chicago that will be used by the numerous interurban lines that are now building toward Chicago. The directors are John Conkey, of Valparaiso; C. H. Jones, B. F. Watson and E. L. Gower, of Indianapolis.

LAKE PROVIDENCE, LA.—The Lake Providence & Gouldsboro Electric Railway & Power Company has been granted a franchise to build an electric railway three miles long from Lake Providence to Lake Providence Landing.

PITTSFIELD, MASS.—The Pittsfield Street Railway Company has bought about five acres of land in Seymour Street, to be used as a site for a new powerhouse.

NAHANT, MASS.—The Nahant & Lynn Street Railway has been authorized by the Railroad Commission to capitalize the cost of building and equipping its railway at $50,000.

ORAN, MO.—The Oran Electric Railway Company has been formed by M. G. Gresham and George Metz; capital, $50,000.

BUFFALO, N. Y.—The Stratford Railway Construction Company, of Buffalo, has been incorporated; capital, $50,000. Directors, L. B. Grant, W. J. Bagnell, C. T. Lark, New York.

LIMA, N. Y.—The accounts, franchises, rights of way, property and assets of the Lima-Honeoye Electric Light & Railroad Company have been sold by Receiver Charles B. Hill to William J. Connors, of Buffalo. The price paid was $16,000. It is understood that the road will now be extended.

NEW YORK, N. Y.—The earnings of the Metropolitan system for June were the largest for any June in its history, aggregating $1,887,834, as compared with $1,865,065 in June, 1904. The record month of the system was May, 1903, when $1,948,795 was earned. The heavy travel in June is partly ascribed to the hot weather, which has lessened the subway business.

MT. VERNON, N. Y.—The New York, Westchester & Boston Railway Company is arranging the details of its franchise with the city of Mt. Vernon. The City and County Contract Company, which holds the contract for the building of the entire road, will advertise for competitive bidding within the month on several additional sections of the work, including the section into Mt. Vernon. The Mt. Vernon Board of Aldermen set July 27 as the day for the hearing on the new franchise.

TOLEDO, OHIO.—A deal has been consummated by which the Widener-Elkins syndicate of Philadelphia takes over the Toledo, Bowling Green & Southern traction line by purchase.

CHATTANOOGA, TENN.—The Chattanooga Electric Railway Company has decided to build a line to Lookout Mountain and another to Chickamauga Park within the very near future, according to an official announcement.

FORT WORTH, TEX.—Steps have been taken looking to the construction of an electric railway from Fort Worth to Azle, a distance of 17 miles. Sterling P. Clark is interested.

CLARKSVILLE, TEX.—A project is on foot to build and operate an interurban electric railway between Clarksville and Sulphur Springs, by way of Cooper and other towns, a distance of 45 miles. Local parties are promoting the enterprise.

GREENVILLE, TEX.—A syndicate of Dallas men will make application to the City Council for a franchise to build and operate an electric railway here. The secretary of the Greenville Commercial Club can give information in regard to the project.

CORSICANA, TEX.—A syndicate of Cincinnati (Ohio) capitalists has taken preliminary steps toward the construction of an interurban electric railway between Corsicana and Fairfield, a distance of 25 miles. R. E. Prince, of Corsicana, can give information in regard to the project.

GAINESVILLE, TEX.—The Gainesville Electric Railway & Light Company will build and operate a new electric street railway system in Gainesville. It has increased its capital stock from $50,000 to $100,000. The company has been reorganized. It has entered into a contract with E. J. O'Bierne for the engineering work of the new railway, and plans and specifications will be completed and the construction contracts let as soon as possible. W. H. O'Bierne is secretary and general manager of the company.

KENOSHA, WIS.—Mr. Fritz Foltz, architect, of Chicago, is making plans and figures on a substation near Kenosha, Wis., for the Chicago & Milwaukee Electric Railway Company. The building will be 40x115 feet, of fireproof construction, of pressed brick and stone. Half will be devoted to machinery, containing three 300-kw rotaries, nine 110-kw transformers and one booster, and the other half to storage batteries.

CITY OF MEXICO, MEX.—The management of the Mexican Tramways, Ltd., of the City of Mexico, has received a petition from the residents of the suburb of Santa Maria asking that the electric railway system be extended to that place. The matter is receiving attention by the railway company and the petition will probably be acted upon favorably.

CITY OF MEXICO, MEX.—The Mexican Government has declared forfeited the concession which it granted three years ago to Jose Garcia and Ernesto Diaz Rugama for the construction and operation of an electric belt railway in the City of Mexico. The guarantee deposit of $25,000 in bonds of the public debt which they deposited is also forfeited.

New Industrial Companies.

THE ELECTRICAL REPAIR COMPANY, New York, has been incorporated; capital, $5,000. The directors are J. G. Eager, Thomas M. Elrath, Jersey City; C. H. Stodin, New York.

THE NORTON ELECTRIC MFG. COMPANY, of Camden, N. J., has been formed. Capital, $100,000. Incorporators: Abner Smith, Frederick G. Norton and David L. Hart.

THE ALPHA ELECTRICAL WORKS, of Superior, Wis., have been formed. The capital stock is $5,000, and the incorporators are Schiller N. Weller, Charles H. Hill and Archibald McKay.

THE NEW YORK ELECTRIC GENERATOR COMPANY has been incorporated in New York; capital, $100,000. Directors: Charles Flavin, Morris Schwartz and Solomon Pulver, New York.

CARLSON & RUSS, of Richmond, S. I., have been incorporated to manufacture engines and motors; capital, $5,000. Directors: C. O. Carlson, J. D. Russ, Staten Island; C. A. Erickson, Brooklyn.

Legal.

HUDSON RIVER WATER POWER.—The temporary receivership of the Hudson River Water Power Company has been vacated and the proceedings connected therewith dismissed by Judge Ray, sitting in the United States Court of the northern district of New York.

DEFECTIVE APPLIANCES.—The Supreme Court of California in the case of Towne vs. the United Gas & Power Company, on the appeal of the defendant, reversed an order denying a new trial, and a judgment in favor of plaintiff. The defendant, an electric light company, furnished its linemen with several pike poles (long poles having an iron ferrule and an iron pike in the end) of the character and construction customarily used in bracing electric light poles while removing the same. One of these pike poles had become dull at the point and unfit to be used with safety. While plaintiff was on an electric light pole, stripping the wires, one of his fellow servants picked up and used the blunt pike pole, which did not fix the electric light pole so as to properly hold the same, and it in consequence fell, whereby plaintiff was injured. Held, that defendant had properly fulfilled its duty of furnishing suitable tools and appliances, and the injury was in no way the result of its negligence. It was also held that the injury was the result of the negligence of the fellow servant, who picked up the defective pole without observing its patent defect.

CUTTING SHADE TREES.—The Supreme Court of North Carolina has decided adversely on the question whether the Asheville Lighting Company, even after it had provided itself with the permission of the Superintendent of Streets, afterward approved by the Board of Aldermen, could cut a tree standing on the outer end of the sidewalk. Mr. Brown sued the company for damages, and the jury awarded him a verdict for $499. It was held on appeal that, while the city had the power, under its charter, to control streets and sidewalks and to remove obstructions when necessary, it did not, when it condemned land for highway purposes, acquite a title to the land, but merely a right of way over it, so that the plaintiff was still the owner of the tree. The authority given the city to permit the erection of poles and wires over the street merely authorized the city to grant franchises, subject to the rights of abutting owners, and an electric light company appropriating any rights of such owner must make compensation. It therefore followed that trees standing on the edge of the sidewalk could not be cut down by an electric company without compensating the owner. Before the company could acquire the right to cut a tree it must show that such cutting was necessary, the mere convenience of removing the tree in erecting poles and wires not being enough to justify it in making the removal.

LIMITING TELEPHONE RATES.—In an opinion filed in the Circuit Court at Baltimore, Md., Judge Harland holds that the Maryland Telephone Company may not charge more than $48 a year for telephones furnished business offices, nor more than $36 a year for telephones furnished dwellings. These rates are for unlimited service of the best character and are prescribed by ordinance No. 110, passed by the City Council and approved by the Mayor on July 1, 1896. This ordinance, the terms of which the Court finds to be binding on the company, provides as follows: "That the prices to be charged by the Home Telephone & Telegraph Company shall not be more than $4 a month for telephones furnished to business offices and not more than $3 a month for telephones furnished to dwellings within the corporate limits of Baltimore City, and to the further express condition that all the rights and privileges hereby and herein granted shall cease and be forever forfeited in case the Home Telephone & Telegraph Company shall be consolidated with any other telephone company in Baltimore, unless the terms of consolidation provide that the consolidated company shall not charge more than the above-mentioned rates for the use of its telephones." In this case it was urged that out of 8,500 subscribers only 18 were parties to the bill, and all the remainder, excepting about 800, who stood on their rights, voluntarily entered into contracts with the company to take the new service at rates of $72 and $60, showing that they believed the new contracts fair and that there was no great interest requiring that a decree should be enforced.

Obituary.

HON. D. S. LAMONT.—The death occurred suddenly on July 23 of the Hon. Daniel S. Lamont, former private secretary to ex-President Cleveland and afterwards Secretary of War. As an associate of Mr. W. C. Whitney he became interested in electric traction and was one of the organizers of the Metropolitan street railway system of New York City. He remained prominent to the end in street railway affairs in New York, Buffalo, etc.

MR. J. H. GATES.—Joseph Holt Gates, an electrical engineer of Chicago, died in that city, after a brief illness. He was born in Brooklyn in 1861, and was the youngest son of the late Gen. William Gates of the Third Artillery, United States Army. Mr. Gates had served in the Twenty-third and Seventh Regiments. He was a member of the Sons of the Revolution, Nassau Boat Club, and the Chicago Athletic and Engineers' Clubs. A widow and one son survive him. He spent many years of his life in the western metropolis in connection with electrical affairs and was often spoken of in electrical circles as "Gates of Chicago."

MR. WILLIAM JESSOP.—Cable advices note the death of Mr. William Jessop on July 4, at his country estate, Thornsett Lodge, Bradfield, England, after a long illness. He was born October, 1856, was educated in Germany, and at Cambridge. At the time of his death, and since 1887, he was chairman of William Jessop & Sons, Limited, steel manufacturers, of Sheffield, England, and was head of the fourth generation of the Jessop family in control of the firm, the business having been established in 1774. He was also President of Jessop Steel Company, of Washington, Pa., president of the Jessop Hospital for Women, an institution founded by his father, the late Thomas Jessop, to which he contributed over $200,000, and which was zealously and liberally supported by his son. He was also a Trustee of the Sheffield Royal Infirmary, and a member of the Bradfield Game Association, and formerly director in the Sheffield & Rotherham Bank and Yorkshire Engine Co. He was a large landowner, worked an estate of 4,000 acres at Huggat, in the Northeast of England, and also an estate at Fosdick, and was keenly interested in agricultural pursuits and an ardent sportsman. He was noted for his kindness and generosity to his tenants, and those in need, and made an excellent landlord, and was greatly esteemed by all He visited Australia, Japan and America, in 1903.

Educational.

UNIVERSITY OF TENNESSEE.—An effective method of bringing to the attention of engineers the engineering features of the University of Tennessee is being used by the Press of the University in the publication of a valuable manual for engineers, which contains a goodly amount of technical information. The object in publishing the book is to increase the interest of men of affairs in technical training, and to present the advantages of technical education as a means of utilizing the undeveloped resources of the South. The popularity of the book is shown by the fact that the present is the fifth edition of 5,000 copies.

THE WORCESTER POLYTECHNIC INSTITUTE has completed plans for the enlargement of its power plant, which will ultimately consist of two 80-hp. and two new 200-hp. boilers, the present engine and generator equipment and the following new apparatus: One 13-in. by 22-in. by 13-in. 175 hp compound engine direct connected with a 2-phase 60 cycle revolving field alternator, a 60 hp direct connected unit, and a 250 hp unit, making about 700 hp. on occasional overload capacity. The two phase alternator will provide current for the institute's lighting and power service at an early date. A blue Vermont marble switchboard in dull black finish with copper trimmings will be installed in 9 panels about 20 feet in total length, and the outfit will not only provide for the service demands of the Institute shops, laboratories and offices, lecture halls and class rooms, but will also be useful for instruction and experimental work.

Personal.

MR. T. D. LOCKWOOD, expert of the Bell Telephone system, arrived in New York recently, after a Canadian trip, from Boston. He will be sailing shortly for England.

MR. B. H. WARREN, president of the Allis-Chalmers Company, returned last week by the "Baltic" from England, after a prolonged stay of three or four months on the other side.

MR. JOHN I. BEGGS, who was receiver of the National Electric Company, of Milwaukee, has now been made trustee of the concern and is carrying on its business in that capacity.

MR. H. WHITFORD JONES informs us that he has withdrawn his active interest from the Cleveland Engineering Company and has opened an office in the Citizens' Building, Euclid Avenue, Cleveland, O., where he will practice his profession as an electrical engineer.

MR. R. CRAWFORD.—It is announced from Chicago that Mr. R. Crawford, a Glasgow traction expert is to visit that city and inspect its possibilities as a field for municipal ownership. Mr. Dalrymple seems to have been a sad disappointment to the municipal advocates.

MR. R. T. LOZIER, of the National Electric Co., has been a visitor in New York recently for the first time in several months. He has been busily engaged with the development and exploitation of the new Lundell motor, and has been successful in its widespread introduction.

MR. GEORGE WESTINGHOUSE has just gone abroad on an extensive trip. Before leaving he formulated as one of the three trustees of the Equitable Life Insurance Society an interesting plan for the "mutualization" of its control, for the benefit of the policyholders.

MR. W. E. COOK, of the Automobile Electric Co., of Chicago, has been a visitor in New York during the past week in connection with important automatic telephonic work that is now in hand. The company has recently received a contract for a 15,000 line system at Havana, Cuba.

MR. W. A. PEARSON.—His associates in the New York City Railway presented Mr. W. A. Pearson, electrical engineer of the road, with a handsome silver punch bowl this week, on the occasion of his departure, August 1, to take up new work at Niagara Falls with one of the large power systems there.

MR. CECIL B. SMITH. A special telegram from Toronto of July 13, says: "Hon. Adam Beck stated, after the meeting of the commission yesterday, that Cecil B. Smith, at present chairman and consulting engineer of the Temiskaming railway commission, has been appointed chief engineer of the Ontario hydro-electric commission, as it is to be known. Mr. Smith will give his entire time to the two commissions. The appointment would appear to indicate the use of electric power on the Temiskaming railway."

MR. J. J. WRIGHT, general manager of the Toronto (Ont.) Electric Light Company, says: It is extremely probable that in the very near future all the railways on the Niagara peninsula will be operated electrically, for the railway locomotive is the most uneconomical form of steam engine there is. There is absolutely no reason why all the trains within at least 40 or 50 miles of the Falls of Niagara should not be operated by electricity. Eventually, no doubt, all the railways in Southwestern Ontario from Toronto westward will be run in that way.

BARSTOW & CHAMBERS.—Mr. William S. Barstow, consulting engineer, New York, and Mr. Frank R. Chambers, Jr., recently of the office of J. G. White & Co., Inc., New York, have formed a co-partnership, as consulting engineers to do a general engineering business in the West. The firm of Barstow & Chambers has opened offices in the Failing Building, Portland, Oregon, and will maintain an office at 56 Pine Street, New York, and thus be in touch at the center with the financial and manufacturing interests of the United States, while the main office in Portland will keep itself informed as to local conditions in the West. Mr. Chambers, who has had a wide experience in reporting upon, designing and equipping large railway and power plants, is located in Portland, where he gives his personal attention to the business of the firm and keeps in continual touch with the rapid development of the West. Mr. Barstow, who is also widely known, is extensively engaged in engineering work in the east, is consulting engineer for the Portland General Electric Company, and is designing the electrical installation of the new 20,000 hp. hydro-electric plant of the Oregon Water Power & Railway Company. This plant is described in our current issue. Mr. Barstow was elected president of the New York Electrical Society in June.

Trade Publications.

THE PIGEON HOLE.—The latest issue of the monthly publication of the Peerless Electric Company, Warren, Ohio, having the above title, contains a few breezy notes on oscillating fan motors, and some thoughts on motors in general, not forgetting that "Peerless motors are good motors."

FAN MOTORS.—The Western Electric Company, Chicago, has issued an extremely handsome catalogue (No. 4005), devoted to W. E. fan motors. The motors are designed for direct-current, alternating current and battery circuits, and in various sizes for desk, bracket and ceiling fans. Both the internal construction and the external appearance of each motor are treated at great length.

GENERATING SETS.—The B. F. Sturtevant Company, of Boston, Mass., has just issued a second edition of its Bulletin No. 63, showing generating sets in a full line of 36 sizes ranging from 3 to 100 kilowatts, and equipped with vertical simple, vertical compound or horizontal engines, according to size. All of these engines are equipped with forced lubrication, watershed partitions and oiltight cases.

DIRECT-CURRENT LIGHTING AND POWER GENERATORS.—The Crocker-Wheeler Company, Ampere, N. J., has issued bulletin No. 53, describing direct-connected, direct-current generators for lighting and power. These machines are regularly built in sizes from 20 kw. to 1500 kw. The bulletin shows not only the design details of the machines, but also exhibits many views of the completed machines in service.

FUSES.—The H. W. Johns-Manville Company, of 100 William St., New York, has issued a 135-page book, designated as the "600-Volt Fuse Bulletin," in which the well-known "Noark" enclosed fuses and fuse devices are fully illustrated and described. The 600-volt catalogue is one of a series of three, the other two being devoted to 250-volt and 10,000-volt devices. These three books describe a complete line of fuse devices suitable for all voltages.

CARTRIDGE FUSE BLOCKS.—Bulletin No. 2 of the Peru Electric Manufacturing Company, Peru, Indiana, is devoted to "Peru" cartridge fuse blocks, which have been designed so as to take any National Code standard fuse. These blocks are exceptionally neat in appearance. The heavy terminals, countersunk in the porcelain, are set back from the end of the block and the porcelain walls extending above the terminals give no possible chance for a short circuit.

DIRECT-CURRENT MOTORS.—The Stanley-G. I. Electric Manufacturing Company, Pittsfield, Mass., has issued bulletin No. 145 which describes at great length a recently developed line of motors and dynamos designated as type "L." These machines are semi-enclosed, with hinged covers protecting the commutator, and are designed to meet the demand for a rugged and compact machine, readily adapted to special uses, such as the direct application to various mechanical devices.

RECORDING THERMOMETERS AND GAUGES.—As sole American representative of Jules Richard of Paris, Mr. E. H. Du Vivier, 14 Church St., New York, is issuing descriptive bulletins devoted to indicating and recording thermometers and pressure gauges and electrical recording instruments. The electrical instruments, including the wattmeter, are of the true recording type, a continuous curve being plotted with time as abscissa, showing the actual reading of the instrument at each instant.

STATIONARY TRANSFORMERS.—The Stanley-G. I. Electric Manufacturing Company, Pittsfield, Mass., has developed a line of transformers in which the losses have been so proportioned as to reduce the cost of operation to a minimum without making the first cost of the transformer unnecessarily high. These transformers are of the shell type, oil being used as a cooling and insulating medium. The windings of the larger sizes are of copper ribbon. These transformers, which are designated as type "Z," are described in detail in bulletin No. 249.

CENTRAL STATION HEATING.—Mr. W. H. Shott, designer and builder of the Schott systems of central station heating and power plants, 1278-22 Marquette Building, Chicago, has issued an exceedingly attractive booklet, which has been given the title, "Eternal Summer," describing the Schott system as built for the Citizens' Mutual Heating Company, Terre Haute, Ind. The booklet contains numerous views of residences to which hot water is supplied. Accompanying the view of each residence is a letter from the owner showing that the heating system has proved entirely satisfactory during the past winter. The farthest building now on the line is connected approximately 8,000 feet from the central station.

"INTERURBAN RAILWAY CONSTRUCTION" is the title of a handsome oblong pamphlet, quarto size, just issued by the J. G. White Company, of Exchange Place, New York City, dealing with some of the concern's electric railway construction and engineering. It is an interesting story of admirable achievement, and embodies what is in every sense a "White" record. The views of power house, plant and line construction are seen at a glance to deal with excellent engineering and execution of broad plans, so that it is no wonder the company is now engaged on work in North America, South America, the Philippines, Cuba, Porto Rico, etc. At the end of the illustrative and descriptive material is some data with regard to the associated White companies here and abroad.

STORAGE BATTERIES.—The Dayton Manufacturing Company, Dayton, O., has issued bulletin No. 130, devoted to Silvey storage batteries, which is a supplement to the general storage battery catalogue, and contains detailed information relative to isolated lighting plants. The bulletin abounds in valuable suggestions as to the selection, installation and operation of batteries in general and describes the several Silvey systems which have been devised to meet the various requirements. The Silvey type "R" cell is unique in that the plates are piled one on top of another, with two sheets of porous absorbent separating material between the plates. Since the elements lie horizontally, it is practically impossible for the active material to fall from the plates, and the cells do not become short-circuited. This type is particularly recommended for isolated lighting plants.

UNIT ACCUMULATOR.—The National Battery Company, Buffalo, N. Y., has prepared some effective publications for bringing the "Unit Accumulator" to the attention of users of storage batteries. To a selected list of persons there has been sent an article entitled "The Future of Storage Batteries." This article was followed later by a discussion on "Sparkers," and still later by another about "Automobile Batteries." These lines are representative of the smallest departments of its business. The company also furnishes storage batteries for street railways, for lighting and power purposes in central stations, for central-energy telephone systems, and a multitude of purposes. There has recently been sent to the persons composing the above-mentioned list a letter calling attention to these facts, and requesting permission to send its general catalogue or a bulletin on any special subject to any one who is interested and cares to receive further information.

News of the Trade.

NEW CARBON PLANT.—The new plant of the American Carbon & Battery Company, Signal Hill, East St. Louis, Ill., is nearly completed. It will greatly enlarge the company's productive facilities.

BELTED STANLEY GENERATOR.—The Stanley Electric Manufacturing Company's San Francisco office has secured an order for an additional 80-kw., 2-phase, 60-cycle belted generator for the plant of the Tonopah Light & Power Company, which has been acquired by the Nevada Power, Mining & Milling Company.

THE STROMBERG-CARLSON TELEPHONE MFG. COMPANY, Rochester, N. Y., reports having closed a contract with the North State Telephone Company, High Point, N. C., for a 1200-line capacity, generator call, visual signal switchboard. The company also reports having closed a contract with the Anderson Telephone Company, Anderson, S. C., for an 1800-capacity lamp, line signal, multiple switchboard.

AMERICAN ELECTRIC HEATERS.—The American Electric Heater Co., of Detroit, Mich., has opened an eastern department, with a New York branch at 35 Dey St. Mr. B. H. Scranton is in charge. This branch has been opened to take care of its eastern trade, which has grown to considerable volume; and it is contemplated to carry in stock a full line of staple devices bearing the well-known "American" trade-mark, including irons of all kinds, heaters, glue pots, chafing dishes, broilers, foot-warmers, etc.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JULY 18, 1905.

[Condensed by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

794,616. SIGNALING APPARATUS; George C. Graham, Buffalo, N. Y. App. filed July 9, 1904. A device by which the ringing of a gong upon one of the cars of a train completes an electric circuit to ring bells upon another car. The gong is made one terminal, and the electric contact is made between the gong and its clapper.

794,645. INSULATOR BRACKET FOR TELEPHONE POLES, ETC.; Knudt G. Springen, Zumbrota, Minn. App. filed Mar. 10, 1905. A wire frame has a pair of projecting pins which virtually act as nails to secure the insulator support to the usual post. The wire frame also has projecting wires which act as a bail or tie to surround the post.

794,647. ELECTROSTATIC MAGNETIC SEPARATOR; W. L. Steele, H. M. Sutton and E. G. Steele, Dallas, Tex. App. filed Feb. 3, 1902.

794,656. CONSTRUCTION ON ELECTRICAL METERS; Otto T. Blathy, Budapest, Austria-Hungary. App. filed Nov. 10, 1902. Relates to details of construction of a current meter and particularly the manner in which the rotating part is pivoted between the supports of the operating magnets.

794,660. THIRD RAIL; Edward R. Brodton, Atlanta, Ga. App. filed Sept. 3, 1904. A construction of third rail which rests upon specially constructed ties to facilitate the drainage of moisture. The rail includes two special conductors which are made use of to operate a form of signaling apparatus within the engine cab.

794,686. PORTABLE AUDIPHONE; E. W. Schneider, New York, N. Y. App. filed Mar. 27, 1905.

794,702. TELEPHONE SYSTEM; W. W. Dean, Chicago, Ill. App. filed May 27, 1901.
(The above seven patents were issued July 11.)

794,742. SOLDERING NIPPLE FOR ELECTRIC CABLES; Henry E. Procunier, Oak Park, Ill. App. filed July 22, 1903. A metallic sleeve is formed with a conical end to be soldered into a correspondingly coned cavity in the usual lead sheath of the cable. The upper portion of the sleeve has a threaded part to screw into the usual box or well. A cavity or path is left in the sleeve for melted solder to flow into the joint.

794,745. AUTOMOBILE STARTER FOR VAPOR APPARATUS; M. Von Recklinghausen, London, England. App. filed Dec. 13, 1904. (See Current News and Notes.)

794,768. ELECTRICALLY OPERATED KEEPER PLATE FOR DOOR LOCKS; August Arens and Ernest L. Teich, New Britain, Conn. App. filed Feb. 20, 1905. An electric door latch in which the pivoted portion has a stud bearing against a cam face on a second pivoted lever con-

794,983.—Rheostat.

trolled by the usual magnet. The leverage of the stud against the cam face is very small so as to insure against binding of the parts.

794,784. BLOCK SIGNALLING SYSTEM; Harry M. Coulter, Chicago, Ill. App. filed Sept. 5, 1903. A cab signaling system in which the signaling circuits are made through contact plates adjacent to the track rails. Employs ordinary relay magnets and secures an overlap system.

794,788. SHIELD AND SUPPORT FOR X-RAY TUBES; Levitt Ellsworth Custer and David H. Allen, Miamisburg, O. App. filed Apr. 6, 1903. The usual support for the X-ray tube has additional arms which support a shield, having a large aperture or light-orifice. Additional rings are arranged to be nested together and attached to the field so as to reduce the light-orifice to any desired size.

794,790. INTERCOMMUNICATING TELEPHONE SYSTEM; A. S. De Veau, New York, and C. Auth, Brooklyn, N. Y. App. filed Sept. 2, 1902.

794,792. DOUBLE CONTROLLER; Charles I. Earll, New York, N. Y. App. filed Apr. 20, 1903. A pair of separate controllers are arranged with co-axial operating shafts and can be used entirely independently, or may be engaged in such a way as to necessitate their successive operation.

794,820. AUTOMATIC RHEOSTAT; Carson J. Studgeon, Erie, Pa. App. filed Feb. 4, 1904. The rheostat operating magnet is wound with a series and with a shunt coil. Both are energized when the motor is started, but the shunt coil is automatically cut out when the motor arrives at running speed in order to avoid the hanging back of the arm, due to "extra current" when the motor circuit is opened.

794,839. ELECTRIC ARC LAMP; M. H. Baker, New York, N. Y., and S. P. Wilbur, Wilkensburg, Penn. App. filed Jan. 10, 1903. (See Current News and Notes.)

794,864. ELECTRIC BATTERY; P. J. Kamperdyk, New York, N. Y. App filed April 2, 1902.

794,868. VAPOR ELECTRIC LAMP; Richard Kuch, Hanau, Germany. App. filed Nov. 17, 1904. The terminals of the lamp are in portions of the tube having an enlarged section, so that the mercury will condense at these points by virtue of the smaller heating effect of the current thereat. Mercury packets further promote the condensation at these points.

794,871. DEVICE FOR INCREASING THE ADHESION BETWEEN WHEELS AND RAILS; Robert C. Lowry, Seattle, Wash. App. filed Oct. 19, 1904. An electro-magnet is arranged adjacent to the usual car wheels so as to magnetize them in operation, the object being to make them grip the rails more firmly.

794,902. ARC LIGHT ELECTRODE; F. O. Vogel, Berlin, Germany. App. filed July 6, 1903. (See Current News and Notes.)

794,924. APPLICATION OF ELECTRIC LIGHTS TO REVOLVERS OR OTHER FIREARMS; Eugene C. I. Cailliez, Lens, France. App. filed Jan. 6, 1904. The revolver handle contains a pair of dry batteries and a circuit is completed by pressing the trigger which lights a small incandescent lamp near the muzzle of the firearm.

794,935. ELECTRIC SWITCH; Monroe Guett, Hartford, Conn. App filed Nov. 1, 1904. The switch operating handle is provided with a rack which engages a pinion to turn the same and tension a spiral spring. After a certain movement the spring is released to throw the switch blade. Additional spring means are arranged to return the switch blade and break the circuit.

794,964. ATTACHMENT FOR TROLLEY POLES; Paul H. White, Indianapolis, Ind. App. filed Aug. 24, 1903. A device for preventing a trolley retriever from catching the trolley wheel upon the upper side of the wire. A pair of cam surfaces upon the pole are adapted to throw the wheel laterally when retrieved to prevent such catching on the wire.

794,967. TELEPHONE SUPPORT; E. P. Baird, Evanston, Ill. App. filed Dec. 19, 1904.

794,983. RHEOSTAT; John W. Howell, Newark, N. J. App. filed Nov. 23, 1903. A rheostat has spirally wound resistance wire thereon and a plurality of contacts may be positioned to place any length of the wire in a simple series circuit, or different parts thereof in a multiple circuit of lower resistance.

794,985. ELECTRICAL FUSE. F. G. Jones, Chicago, Ill. App. filed Nov. 17, 1904.

794,991. MOTOR CONTROL SYSTEM; John B. Linn, Schenectady, N. Y. App. filed Nov. 11, 1901. The contractors are arranged to be operated successively, each of them being actuated by a circuit which is closed by the preceding. In order to avoid too rapid actuation each contractor arm has a dash-pot attached thereto.

794,995. ALTERNATING CURRENT MOTOR; M. Milch, Schenectady, N. Y. App. filed Dec. 21, 1903. (See Current News and Notes.)

794,998. DYNAMO ELECTRIC MACHINE; F. A. Mott, Erie, Penn. App. filed Nov. 27, 1903. (See Current News and Notes.)

795,000. MOTOR CONTROL SYSTEM; William O. Mundy, St. Louis, Mo. App. filed Feb. 20, 1903. A special construction of contactor in which the contact arms form a part of the magnet circuit of the operating solenoid. The shield is so disposed that this magnetic circuit also constitutes a blow-out for the circuit breaking arcs.

795,016. TROLLEY EAR; Montraville M. Wood, Schenectady, N. Y. App. filed Jan. 15, 1903. A rigid frame has a pair of longitudinal slightly inclined grooves therein, and a pair of jaws for gripping so that the wire is gripped when the jaws are moved longitudinally by a suitable rack and pinion engagement.

795,024. PNEUMATIC SYSTEM OF MOTOR CONTROL; Frank E. Case, Schenectady, N. Y. App. filed Dec. 5, 1902. A system by which a train can be completely controlled through two train pipes. The control is not dependent on the mere strength or variations of air pressure, but on the successive manner in which pressure is applied in the two train pipes. Complete control is obtained through a constant pressure applied in a predetermined order in the two pipes.

795,067. PLUG AND RECEPTACLE; Howard R. Sargent, Schenectady, N. Y. App. filed Aug. 17, 1903. A porcelain frame has apertures for the attachment of metallic clips which project at opposite lateral faces to form plug sockets. The construction is designed to be strong and withstand rough usage.

795,072. CUT-OUT FOR TELEPHONES; M. L. Smith, Rutledge, Missouri. App. filed June 7, 1904.

795,137. SAFETY SIGNAL SYSTEM; Frank V. King, Winslow, Arizona Ter. App. filed Dec. 14, 1904. In order to relieve the mind of the engineer of the train dispatcher's orders which he is required to execute at various points, a gear train driven from the car axles is arranged to ring an alarm circuit at any predetermined point or points of the route where the engineer has received orders to do something.

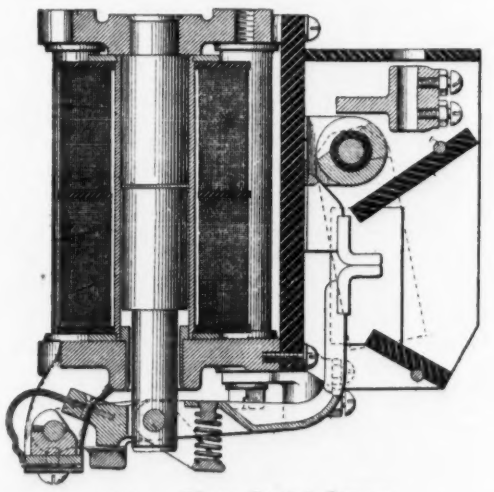
795,155. BEDSTEAD; Arabella A. Nees, New Orange, N. J. App. filed July 14, 1904. A usual bedstead frame is provided with a pocket in which valuables may be placed. The cover can only be removed by a push-button which rings a burglar alarm.

795,170. ELECTRIC BRAKE; W. G. Price, Pittsburg, Pa. App. filed Aug. 17, 1904. A mechanism provided with a brake-applying spring and a motor having a rotating armature for compressing the spring and releasing the brakes.

795,182. PROTECTIVE SYSTEM FOR PARALLEL LINES. L. Wilson, Pittsfield, Mass. App, filed Nov. 20, 1903. (See Current News and Notes.)

795,197. SELF-SOLDERING PROTECTIVE APPARATUS; F. B. Cook, Chicago, Ill. App. filed Dec. 20, 1904.

795,201. ELECTRICALLY HEATED HANDHOLD; Fred S. Davis, Robertsville, S. C. App. filed Dec. 29, 1904. Within each of the handles of the usual steering wheel is placed an incandescent lamp, in order to warm the handles in cold weather.



795,000.—Motor Control System.

795,235. ELECTRICAL SWITCH AND OPERATING MECHANISM THEREFOR; Willard F. Richards, Buffalo, and William A. Turbayne, Lancaster, N. Y. App. filed Apr. 9, 1904. The switch blade is longitudinally movable over different contacts and can be stepped along in either direction by a reciprocable bar having ratchet notches thereon. An oscillation of the bar in one direction produces a movement of the switch blade one way, and an oscillation in the opposite direction moves the switch blade in the opposite way.

795,243. RAILWAY BRAKE APPARATUS; Granville T. Woods and Lyates Woods, New York, N. Y. App. filed Apr. 10, 1903. A complete motor control system in which under certain conditions the current is directed through the coils of a magnetic brake.

795,247. CURRENT COLLECTING SHOE; William M. Brown, Johnstown, Pa. App. filed Jan. 26, 1903. The shoe is made very long in order to bridge over spaced contact plates, and comprises a series of independently pivoted spring blades each of which completes a circuit when it is pressed upward by passing over the spaced contacts.